# REPORT RESUMES

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FOUR CASE STUDIES OF PROGRAMED INSTRUCTION.

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DESCRIPTORS- *PROGRAMED INSTRUCTION, INSTRUCTION, AUTOINSTRUCTIONAL AIDS, PROGRAMED MATERIAL, PROGRAMED TEXTS, TEACHING MACHINES, *PROGRAMING PROBLEMS, *PROGRAMS, *TEACHER ATTITUDES, TEACHER EVALUATION, *STUDENT REACTION, SCHOOL SYSTEMS, SCHOOLS, STANFORD, CALIFORNIA, MANHASSET, NEW YORK, DENVER, COLORADO, PROVO, UTAH, FUND FOR THE ADVANCEMENT OF EDUCATION, FORD FOUNDATION

SEVERAL SCHOLARS, KNOWLEDGEABLE BOTH ABOUT SCHOOLS AND PROGRAMED INSTRUCTION, WERE ASKED TO LOOK AT A SCHOOL OR A SCHOOL SYSTEM WHERE PROGRAMED INSTRUCTION WAS IN USE, AND REPORT ON IT. SPECIFIC QUESTIONS POSED WERE--(1) WHAT HAD CERTAIN SCHOOLS DONE WITH PROGRAMED INSTRUCTION, (2) WHAT WERE THEIR REACTIONS TO THE EXPERIENCE, (3) WHAT PROBLEMS HAD THEY FOUND IN PUTTING THE METHOD INTO EFFECTIVE USE, AND (4) WHAT IS THE PRESENT OUTLOOK FOR PROGRAMED INSTRUCTION IN THE SCHOOLS. FOUR CASE STUDIES DEALING WITH THESE QUESTIONS ARE IN THIS REPORT--(1) PROGRAMED INSTRUCTION IN THE MANHASSET JUNIOR HIGH SCHOOL, (2) PROGRAMED INSTRUCTION IN DENVER, (3) EXPERIENCES WITH PROGRAMED MATERIALS IN THE CHICAGO AREA, AND (4) PROGRAMED INSTRUCTION IN A "CONTINUOUS PROGRESS" SCHOOL IN PROVO, UTAH. IN ADDITION TO AN INTRODUCTION BY WILBUR SCHRAMM, THERE IS A REPRODUCTION OF PART OF SCHRAMM'S EARLIER BOOK, "PROGRAMED INSTRUCTION TODAY AND TOMORROW," PUBLISHED BY THE FUND FOR ADVANCEMENT OF EDUCATION IN NOVEMBER 1962. SUGGESTIONS FOR FURTHER READING WERE ALSO INCLUDED. (JC)

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# Four Case Studies of
# Programed Instruction

No 5

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# Programed Instruction

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Four Case Studies of

# Programed Instruction

Fund for the Advancement of Education

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## CONTENTS

8 Introduction: Interim Report
WILBUR SCHRAMM

17 Programed Instruction in the Manhasset Junior High School
JOHN HERBERT and ARTHUR W. FOSHAY

29 Programed Instruction in Denver
WILBUR SCHRAMM

41 Experiences with Programed Materials in the Chicago Area
HERBERT THELEN and JOHN R. GINTHER

65 Programed Instruction in a "Continuous Progress" School —Provo, Utah
JACK V. EDLING

97 Appendix: Programed Instruction Today and Tomorrow (a reprint)
WILBUR SCHRAMM

117 Suggestions for Further Reading

# Introduction: Interim Report

*In a small book published by the Fund for the Advancement of Education, some eighteen months ago, I had this to say of the state of programed instruction:*

"Programed instruction is, in the best sense of the word, a truly revolutionary device; but it is revolutionary, not so much in itself, as in its ability to interact with certain other developments in education. This interaction has the potential of freeing schools and men from old bondage and outworn theories and practices. But the potential is, so far, largely unrealized.[1]

*Later on in the book, I was more specific:*

"1) Although the research gives us little reason to be satisfied with the theories and the standards of today's programing, and every reason to believe that it will be possible some day to make programs vastly more effective than today's programs, nevertheless programed instruction shows signs of hardening, partly under commercial pressure, into a fixed and mechanical technology, with theories and procedures taken for granted.

"2) Although programed instruction has within it the potential to turn the attention of education and educational research more intensively and productively than ever before to the processes by which humans learn, there is very little sign that it is being used productively to test theories of human learning or theories of cognitive process, or to enlighten the teacher concerning the process by which she teaches.

"3) Although programed instruction is essentially a revolutionary device, in that it has the potential to help free man from some of of his bondage – the waste of human resources where there are no teachers or where people cannot go to school; the waste of time and talent where all students are locked into the same pace, and all teachers into the same routine; the tyranny of tradition which permits the study of a certain topic to begin only at a certain age, and expects a student to accomplish only so much as a questionable test of his ability says he can do; and the inadequacy of outmoded and inadequate curricula – despite this, programed instruction is very slow to rise to such a revolutionary potential."[2]

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[1] Wilbur Schramm. *Programed Instruction – Today and Tomorrow*. New York: The Fund for the Advancement of Education, 1962, p. ii. *See also*, Appendix, page 97.

That is how the situation looked late in 1962. Now, a year and a half later, where do we stand?

Programs? The number has been growing at an almost exponential rate – a handful in 1960 and 1961, 122 in 1962, 352 by September 1963.[3] Some hundreds must have been published since that time. Furthermore, one gets the impression – although with very little hard evidence behind it – that the average quality of programs is rising. Some of the newer programs are more interesting to look at, and more interesting to read, than most programs used to be. A few programs have come out with effectiveness data based on solid testing. A few programers are talking about "discovery teaching." There is more concern than formerly, among publishers and programers, as to whether the substantive content is the best that can be assembled. At least one of the great curricular revision projects, the School Mathematics Study Group, has developed its own programed texts. On the whole, therefore, the outlook is encouraging. But progress is very slow, and we are still a long way from having either enough good or good enough programs to test the full potential of programed instruction.

Research? Since 1962, research has moved slowly, carefully, toward identifying the characteristics that make for more learning from one type of program than from another. Much of this research has, in effect, tested rules of programing. Some of it has tested what we might call audience fit – for example, the use of programing with very bright children, or slow learners, or nonreaders, or industrial trainees. There have been some very impressive research products, such as the volume edited by Lumsdaine, *Student Response in Programmed Instruction,* which became available just as my previous volume in this series was about to be printed.[4] But on the whole, I think, it is safe to say that there has been no striking "breakthrough" into new levels of understanding of human learning, attributable to the study or use of programed instruction.[5] And perhaps this is the curve of progress we should expect – many small advances, resulting, over time, in the accumulation of insights to the size of a critical mass.

What can we report of programed instruction in use? In 1962 and 1963 the use and making of programs spread to many parts of the world. Especially in England, Japan, Germany, France, Scandinavia, and the Soviet Union there has been a lively interest in the method, a flurry of activity in programing, scholarly writing on the method, and the production of teaching machines. In Japan alone, more than 1000 short programs are reported to have been written by teachers. Workshops in Nigeria and Jordan, in the summer of 1963, introduced the method to sub-Sahara Africa and the Middle East. Ethiopia has adapted some English-language programs, and programing is an important part of a science curriculum revision project in Brazil. It is too early yet to tell whether programed instruction is going to be able to play the great role some have envisaged for it in the developing countries, where teachers and schools are in such short supply; but first reports are hopeful.

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[2] *Ibid.,* pp. 37-8; Appendix, p. 114.

[3] *See* L. F. Hanson, ed. *Programs, '63.* Washington, D. C.: U. S. Office of Education, 1963. This report contains listings and sample pages from all or most of the programs commercially available in the United States by September 1963.

[4] A. A. Lumsdaine, ed. *Student Response in Programmed Instruction.* Washington, D.C.: National Academy of Sciences–National Research Council, 1961.

[5] For an annotated bibliography of research on programed instruction up to early 1963, *see* W. Schramm, ed. *The Research on Programed Instruction.* Washington, D.C.: United States Office of Education, 1964.

It is in the schools of the United States, however, that programed instruction is having its chief test. What has been happening to the large number of school programs that in the last three years have moved out of the experimental and laboratory stage to the stage of being commercially available? How extensively are they being used? Are they being accepted by teachers and pupils? Are they being discarded after trial, or being worked into the long-term programs of the schools? Are they helping to "free man from inadequate curricula, from inflexible concepts of 'readiness' and abilities, from the poverty of the self-contained classroom and the lockstep of annual progress . . . from inadequate theories of learning and an inadequate use of capacities to learn"?[6] These are the tests by which programed instruction will ultimately be measured. It is appropriate at this time, when programs have been available for long enough to make possible an interim report, to ask how the tests are going.

It is apparent that programed instruction has not exactly swept like a prairie fire through the schools. Rather, educators have experimented gingerly with it, and been slow to adopt it. There are no solid figures on the proportion of American schools that have tried or are using programs. A survey by the Center for Programed Instruction, in the 1961–62 school year, got back a little over 2000 replies from 15,000 questionnaires to school superintendents, and the authors, of course, made no attempt to project national figures from those data.[7] The survey does, however, supply some suggestive data on the users of programed instruction who responded to the questionnaire. For example:

– More than half the programs in use by the respondents are on a limited trial basis (p. 11).

– About four times as many of the programs in use come from commercial sources as from local construction (p. 26). Even so, it is noteworthy that as many as one of five programs were locally made.

– The great bulk of use (at least among schools that answered the questionnaire) seems to be in school systems where enrollment is over 1000 (p. 38).

– There appears to be more use in junior high schools (seventh, eighth, and ninth grades) than in either senior high or elementary schools (p. 43).

– The majority of programs in use were mathematics programs: 60 per cent of schools reporting said they were using programs in mathematics; 21 per cent in English; 4 per cent in foreign languages and the same in spelling; 3 per cent each in science and social studies (p. 26).

– Teacher evaluation of the method was said by 22 per cent of the questionnaires to be "enthusiastic"; on 55 per cent, "favorable"; 15 per cent, "neutral"; and only 5 per cent "opposed." Reactions of administrators, parents, pupils, and board members were reported to be not greatly different from those of teachers, although smaller percentages of parents and board members were "enthusiastic" (pp. 20–21).

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[6] W. Schramm, *Programed Instruction–Today and Tomorrow*, New York: The Fund for the Advancement of Education, 1962, p. 36; Appendix, p. 97.

[7] *The Use of Programed Instruction in U. S. Schools: Report of a Survey of the Use of Programed Instructional Materials in the Public Schools of the United States During the Year 1961–62.* Compiled and produced by Research Division, The Center for Programed Instruction, Inc., in cooperation with the U. S. Department of Health, Education, and Welfare, Office of Education. Washington, D. C., 1963. A later survey is now in press, and a personal note from the authors reports almost identical percentages for 1962–63.

—"Different school systems of similar size and type using the same program under similar circumstances came up with quite different evaluations" (p. 36).

It seemed to us worthwhile, at this stage of the development of programed instruction, to look behind such survey figures, and analyze the experiences of at least a few schools in more detail. Therefore, we asked several scholars, knowledgeable both about schools and programed instruction, to take a hard look at a school or a school system where programed instruction was in use, and report on it: What had these schools done with programed instruction? What were their reactions to the experience? What problems had they found in putting the method into effective use? What is the present outlook for programed instruction in those schools? The four case studies in this book are from the group of studies thus commissioned.

The cases are interestingly different. Thelen and Ginther began with a small survey of school systems in the Chicago area, trying to find out how widespread the use of programs had been, and what the reactions had been. Then they tried to identify the circumstances and characteristics that seemed to go with favorable or unfavorable results, and interviewed in detail a number of teachers, half of whom were pleased, half of whom displeased, by the experience. On this basis they arrived at some tentative conclusions as to what will be required if programs are to "work" as instruments of truly individualized instruction.

Herbert and Foshay, on the other hand, concentrated on one school, the junior high school at Manhasset, New York. Here they found very different reactions to programed instruction in different grades, and tried to sort out some of the reasons for the discrepancy. In the grade where the initial program was successfully introduced, they analyzed the efforts made to "individualize" the use of the program, and reported the rather unexpected results of these efforts on teaching patterns and practices.

Schramm, in Denver, found a school system that had very early opted for constructing its own programs, rather than seeking commercial ones. Here, too, there were successful experiences and unsuccessful ones. The case study follows the development and introduction of the programs, analyzes the considerable amount of research done on them and the efforts to make the programs part of a "team," and concludes with a report of what Denver now thinks of the feasibility of a school system making its own programs.

Edling studied the Brigham Young University laboratory school in Provo, Utah, which has gone perhaps as far as any school in using programs in such a way as to make possible individual rates of progress. Edling interviewed administrators, teachers, pupils, and parents, tape-recorded the conversations, and reproduced long sections of the interviews verbatim in the case study. Thus we can listen in on what persons chiefly concerned with a "continuous progress school" have to say about the experiment.

These cases are not representative, in any statistical sense, of the American experience with programed instruction, but we hope and expect that readers will find them rich, suggestive, and sometimes provocative.

We do not wish to abstract or discuss the four cases so extensively in these next few pages as to take any of the pleasure out of reading them. But it is worth pointing out, by way of introduction, that certain themes and questions run through all four cases, and apparently are representative of the problems encountered by a great many schools with programed instruction. Perhaps the most basic of these questions is how and to what extent programs can be used in the schools to individualize, rather than merely enrich, instruction.

### ENRICHMENT OR INDIVIDUALIZATION?

There is no longer much doubt that many existing programs are efficient, self-contained tools of instruction which can be made part of a total teaching experience. For example, a teacher can confidently assign programs to help teach the use of the slide rule, when to write *it's* rather than *its,* how to multiply fractions, or a foreign language vocabulary. In certain subjects, programs are available which will enable a student to undertake a further range in learning by himself. In other words, there is now plentiful evidence that programs can be used, under suitable conditions, for enrichment or remedial study. But this is only a subsidiary goal of programed instruction. The hope has always been that programs would be the magic key to the door of *individualized* instruction — that they would liberate a student from the lockstep of a heterogeneous class, let him move forward at his own best pace and go as far as he can, release teachers from much of the routine of exposition and drill and let them concentrate on smoothing and enriching the progress of individual students. This has been the hope. But these four studies show that it is still far from being completely realized.

In Denver, the locally made programs were designed, from the first, to be teacher-aids; the effort was rather to keep the students together than to encourage divergent rates of progress. In the Chicago situations, the teachers who tried to use programs in an individualized way, as recommended by the publishers, were the least happy with programed instruction (it is pointed out that the recommended way was not an adequate one). In Manhasset, where some efforts were made to individualize the study of English grammar in the eighth grade, and in Provo, where the experimental school went further than any of the other schools toward individualizing instruction, considerable problems had to be overcome before even parts of the curriculum could be individualized.

### THE PROBLEM OF MATERIALS

Let us note some of these difficulties. One of the problems in the way of truly individualized instruction is that of finding suitable materials. The great number of commercial programs on the market is hardly reflected in the small number of programs which these alert and interested school systems have been able to identify as suitable to their needs. The example of Provo is instructive. This school, dedicated to the use of programed materials, was able to put together a fairly complete set of mathematics programs, first grade through twelfth. It found two grammar programs for high school, and two spelling and vocabulary programs for elementary school. At the time of Edling's report, that was all. Even in that experimental school, therefore, most of the curriculum still depended on orthodox materials.

Another difficulty in finding suitable programs is that it is hard to tell a very good program from a fairly good one. Both Manhasset and Denver agreed that teachers could judge the substantive content of a program and could identify the flaws that distinguish a skillful program from an unskillful one.

But when it comes to judging the relative effectiveness of two programs that do not have gross flaws, the only way for a school to do that is to depend on research evaluation evidence provided by the publisher – or to make its own tests with students. Since very few programs come equipped with such evaluative evidence, the only real alternatives are to test them, which many schools are ill-equipped to do, or to adopt one on a hunch – and the second alternative often results in disappointment, and reluctance to try other programs.

It seems clear that the great preponderance of programs will be made by or for commercial publishers, because the process is too costly for individual schools. This is the import of Denver's experience with making its own programs. Denver feels it has benefited greatly by the exercise of making some programs, but is looking to commercial suppliers for most of its needs in the future.

That being the case, program makers will find certain thought-provoking notes in these four case studies. For example, one disturbing item emerges from the experience of Provo and the Chicago schools, where it is suggested that a wider range of programed materials will apparently be required than had been expected. The more the responsibility for teaching is carried by the program, the better the program must fit each student's needs and ways of working. "If the program guides 90 per cent of the activity of the student," Thelen and Ginther say, "whatever accommodation can be supplied by the teacher must be squeezed into the remaining 10 per cent of activities." Edling came to the same conclusion. If programs are used for enrichment or remedial purposes, where the teacher can develop readiness and take care of difficulties, they can cater to a considerable range of student abilities; but if they are used by the student mostly on his own, then the selection of the program ideally must take into account the individual's reading level, present understanding, approaches to meaning, and other characteristics. There is apparently little likelihood that programs, used for individualized instruction, are going to serve wide bands of individual differences. More branching within programs, more dependence on small units which a teacher can combine in such a way as to meet individual needs and abilities, ultimate use of computer programs to provide a great variety of paths through a learning experience – solutions like these seem to be called for.

Another bothersome problem is the relative inflexibility of programs in relation to curriculum. For example, Manhasset adopted a mathematics program, then found it useless the next year when the curriculum changed to the "new" mathematics. Teaching methods in the classroom are relatively flexible. If most of the class time is controlled by the teacher, therefore, curricular changes are hard enough but still feasible; but if most of the time is controlled by programed materials, which are relatively inflexible, then change will come hard and be costly.

### THE PROBLEM OF STUDENT SATISFACTION

From these schools, and from most others who have reported their reactions to programs, comes the word that some students find programs "boring." Some students, some programs, some schools, of course, more than others. There are provocative pages on this point toward the end of the Thelen-Ginther paper. Two things especially impressed them about some student reactions, they said. One was the "elaborate and ingenious ways of short-cutting the program"; another, "the phenomenon of going through the program, apparently satisfactorily, and then being unable to pass tests or answer questions about what it is that one has been reading or answering." These phenomena, and the reports of boredom, had better be taken seriously, they say – for "the alleged reward from immediate feedback, telling the student that he has made the right response, is simply inadequate."

Certainly a large number of social and interpersonal rewards which are taken for granted in classroom teaching, are almost wholly absent in individualized programed instruction. What rewards can be substituted? Although the teacher can do a great deal, Thelen and Ginther think the ultimate responsibility lies with programers, and the ultimate solutions will be more rewarding, more challenging programs. Until programing principles are established to "turn education into an experience of meaningful inquiry by the student," they doubt that it can be truly individualized; it will depend on management and enrichment by the teacher, who will consequently tend to use programs chiefly as a new and efficient type of workbook to help "teach the class."

Edling went to Provo with the same general point of view – that programs are not yet sufficiently developed for a fair public trial in individualized teaching – but somewhat modified his view there. He concluded that in some fields, and at some grades, there is apparently sufficient material for the purpose, although – to say the obvious – programs today are not what programs will and must be.

### THE PROBLEM OF TEACHER SATISFACTION

Many teachers are suspicious of programs, and become frustrated and unhappy when they turn over any large part of their control to programed learning. A sad little vignette is painted, in the Chicago case study, of two teachers who conscientiously followed the publisher's instructions to let the students go at their own pace, then discovered that the students were not learning what they were expected to, felt they should hold class on certain difficult topics, but found it practically impossible to do so effectively because the students were at different places in the program. The teachers suffered out the semester angrily, helplessly.

On the other hand, *some* of the Chicago teachers, the Denver teachers of Spanish, the eighth-grade teachers in Manhasset, and apparently most of the Provo teachers were quite happy with their experiences, and it is worth examining these case studies to see how this reaction was accomplished.

Let us record also a note from the Provo experience which may tend to correct some less realistic dreams of what may be expected from individualized programed instruction. There is no indication, from Provo, that individualized instruction in an adequate school context requires either fewer teachers or less well-trained teachers. Just the opposite, say the Provo people. It requires as many or more teachers, although a certain number of "lay readers" or other such helpers may be used. And, if anything, it requires a teacher to know her subject more broadly and more deeply.

### THE PROBLEM OF CONTEXT

We come finally to context, just as all these case studies do.

If programs are to be used for enrichment and remedial purposes, as by Denver and by the elementary-school mathematics teachers interviewed in Chicago, then it is necessary but relatively easy to fit the program into classwork. The teacher, if at all skillful, can introduce the program at the right time, prepare the pupil for it, carry over the learning into other class activities. A teacher can also convey his own supportive attitude. In Denver, it was found that the more favorable the teacher's attitude toward the subject, the better the students did with a program, even though the entire teaching of the subject (in certain experimental groups) was done by television and programed instruction, and all the teacher did was keep order! Context and attitude are variables that run through these four cases. And in the CPI survey, previously cited, context and attitude differences must be among the chief reasons why the same program was received quite differently in different schools.

Even in the use of programs for enrichment and remedial purposes, therefore, context is important. But if programs are to be used for really individualized learning, then an adequate context is essential.

On the basis of these studies, it appears that truly individualized instruction with programed materials can be achieved only by a really major change in the context of teaching and learning. Individualized instruction can't go forward with business as usual. The order of magnitude of the necessary change is suggested by what happened in Provo, where, in some parts of the curriculum, the self-contained classroom became a casualty of progress, the students moved much of their learning activity into the study carrels, and the teachers mastered a new role. Edling's report describes in some detail what the Provo school did.

The Manhasset experience, too, on a much smaller scale, supports the need of contextual change. Here a group of eighth-grade teachers were trying to do nothing more sweeping or drastic than to use a grammar program for individual instruction. In order to do this they found they had to make very considerable changes. This section of the Herbert-Foshay report will be most interesting to readers of this book, for it shows not only the difficulties of introducing individualized instruction, but also some of the desirable (and unexpected) by-products. The self-contained classrooms gave way to more flexible arrangements and new teacher roles. The eighth—grade teachers found themselves spending a substantial part of their free time in cooperative planning and evaluation of their program. They found themselves questioning previously unexamined assumptions about subject matter, teaching method, prerequisites, and student needs. They found themselves organizing their teaching in new ways, using more instruction in large study halls with teacher help readily available, more individual conferences, and the assistance of a lay reader. Indeed, they were engaging in a kind of team-teaching without a formal team organization. They discovered that the new arrangements gave almost all students more time to practice creative writing, and students who needed it, more opportunity for remedial grammar.

Thus Manhasset received a considerable dividend from the introduction of one small program in English grammar, individually studied. The experience encourages us to believe that even though great problems must still be solved before programed instruction can be widely used for individualized instruction in the schools, the effort to solve those problems is worth making.

The cooperation of the schools represented in the case studies that follow, and the candor of their administrators and teachers in talking about their experiences with programed instruction, we gratefully acknowledge.

# Programed Instruction in the Manhasset Junior High School

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# Programed Instruction in the Manhasset Junior High School

Innovation in the school is like innovation in any complex environment. Bring a single new species of insect into a forest and you may remake a landscape; plant a new crop and you may alter the economy of a nation. Similarly, programers design programs to achieve highly specific objectives, yet school systems find that the introduction of programed instruction may lead to diverse and unexpected changes. As with other innovations, the success or failure of a program seems to depend in large measure on its appropriateness to the original environment and on the skillful identification and handling of the changes which the innovation touches off.

Manhasset Junior High School has introduced several programs, each time under different circumstances, and each time encountering different problems and attempting different solutions. This account is an attempt to describe, in retrospect, some of the forces which significantly affected the introduction of programed instruction into this school during the years 1960–63, and some of the changes which took place. The information on which the study is based was obtained through individual and group interviews with the principal and two eighth-grade teachers, through brief observation, and through examination of material written by the school staff. Where information given by various sources differs, we have relied on statements made in interviews with the school staff. From these interviews we have also derived the judgments, explicit or implied, which are presented here. Implicit in this material is our central point that, however restricted the aims of a program, its introduction is likely to change the allocation of resources, the organizational forms, the distribution of the time of teachers and pupils among the various subjects, and the personal and political relationships inside and outside the school.

Located in suburban Long Island, Manhasset is within easy commuting distance of New York City. The school district includes a number of small incorporated townships and an unincorporated area. Residents of these communities expect their children to go to college and can afford to send them there. Seventy-five per cent of the pupils of Manhasset enter four-year colleges on leaving high school, and another 15 per cent follow within the next five years.

Manhasset is a pioneer in the use of programed instruction. In 1961 only one other school district in New York State was using programs, according to a survey made for the State Education Department by Dr. Henry M. Brickell, assistant superintendent of schools in Manhasset.[8] The results of three years' experience at Manhasset are by no means those which the innovators foresaw in 1960.

## English 2600

Early that year, a ninth-grade teacher obtained a sample copy of *English 2600*,[9] a program in grammar and usage. She passed this on to the principal, who in turn showed it to some other teachers. The assistant superintendent for instruction expressed interest and support.

In Manhasset at this time, English grammar was taught informally in elementary school, more formally in grade 7 in self-contained classes and in grade 8 during the English-social studies block period, and again in the senior high school. As might be expected, there was some concern over the teaching of this subject. Some teachers felt that school grammar was "nonsense"; others were dissatisfied with the effect on the children of previous teachers' efforts to teach grammar. Nevertheless, the schools felt committed to teach formal grammar, partly because pupils would need it for college and for foreign language instruction, and partly because the community expected it.

When the possibility of adopting *English 2600* was put before them, most of the teachers were opposed to trying the program. Some pointed out that median scores of Manhasset children in the junior high school were on the average two years above national norms and that, as might be expected from their home backgrounds, the children were already speaking and writing well. The teachers felt that their present methods were adequate and saw no evidence that change would mean improvement. Other innovations were in progress, moreover, and the new grammar program seemed unlikely to prove as significant as some of these.

One eighth-grade teacher, however, was greatly interested, as were the principal and assistant superintendent for instruction. After some discussion, the teachers agreed to give the new program a trial.

### SETTING UP THE PROGRAM

The way in which the program was used during the first year seems in retrospect to have been determined primarily by the circumstances under which it was adopted. There was no possibility of benefiting from another school's experience with *English 2600*, and little was known about the effects of programs. A number of teachers were opposed to the introduction of programed instruction, and so it was necessary to persuade them that the new program would instruct pupils at least as well as traditional methods and might save teacher and pupil time. An experimental design carefully enough controlled to permit a generally valid assessment of the program might have been persuasive, but would have increased tension by imposing additional work on teachers who had no confidence in the innovation. A purely exploratory program, planned to enable interested teachers to become acquainted with the new method, would have produced no evidence of its effectiveness. Experimental results were essential at least for local consumption. The result of this conflict was that the actual procedure chosen was too narrow for satisfactory exploration of a new teaching method, and not extensive enough or carefully enough controlled for an accurate measurement of the effects of the program on pupils. In retrospect, the staff members agree that the arrangements of the first year were not adequate. They believe, however, that, given the same circumstances, they might again proceed in the same way.

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[8] Brickell, Henry M. *Commissioner's 1961 Catalog of Educational Change*. Albany, New York: State Education Department, 1961. The survey covered all of New York State, except New York City.

[9] Blumenthal, Joseph C. *English 2600, A Programed Course in Grammar and Usage*, revised edition. New York: Harcourt, Brace and World, 1962. The school district purchased the earlier edition of the text and the test in 1960, and is still using many of the original copies. *English 3200* is a similar, more extensive program intended for grades 11 and 12.

The arrangement was that one seventh-grade class and two eighth-grade classes would be taught, in a testing atmosphere, solely by the *English 2600* program, while all other classes in these grades would continue to be taught by the methods which had been customary before. Grammar would be taught to the experimental groups in three half-hour class periods per week and at no other time, and the teachers were not to teach or help the children at all. Teachers in other classes would, as before, teach grammar when necessary as part of the 90-minute English-social studies block period. The test supplied with the program would be given to all 200 children before the experimental group started the program, and again after a period of six months.

### FIRST YEAR RESULTS

A comparison was made between the average growth shown by the scores on the pretest and post-test of the experimental and control groups. The school system made available $1,500 for tabulation and statistical work to be done by a local firm, a move by the assistant superintendent to reduce the extra load any innovation places on the staff. The statistical consultants found that the experimental groups in grades 7 and 8 had made significantly higher gains. These differences of achievement were significant at or beyond the .02 and the .01 levels, respectively.

For several reasons it is difficult to interpret these findings. First of all, the test used was the one designed to test the material of the *English 2600* program, and no clear evidence exists that the content taught in the other classes was comparable. The teachers, however, felt that in general the program covered substantially the same ground as the Harcourt-Brace grammar textbook which the control groups had been using.

Matching of experimental and control groups was also something of a problem. The pupils' IQs and the number of questions they chose to answer were found to have affected the scores and these variables were controlled statistically, but other characteristics were not compared.

The teachers and the principal were certain that the program saved substantial time, especially for the abler pupils. A record was kept of how much time each pupil spent on the program, but the figures were not compiled and are not available. The amount of time devoted to grammar by each pupil in the control group is not available either. This information would have been especially difficult to gather, since grammar was taught at various times during the English-social studies block, in supervised study, and by homework. Teachers' estimates of how much time they spent teaching grammar through the year vary greatly. Thus, the only evidence that the program saves pupil time is the judgment of the experienced teachers involved in the experiment.

### TEACHERS' CONCLUSIONS

Though the experimental design was far from rigorous, the results and conclusions drawn from observing the program convinced the administration and the eighth-grade teachers that a continuation of the program would be worth while, although it was clear that the semi-experimental design employed that year was not the best way of using the program for teaching. They had no doubt that most of the abler children had taken much less time to master the material than they would have spent in conventional classes, and that the time thus made available to them for other purposes was substantial. One student had completed the entire program in nine and a half hours, and the average working time was estimated at 23 hours. The less able students, however, did not finish the program. Some, indeed, had been unable to pass any of the tests satisfactorily. They had spent 33 hours or more on the program, and so had saved no time at all. Even during the third year of instruction by program, in 1963, about 30 per cent of the pupils failed to complete the program after six months of work.

The seventh-grade teachers, on the other hand, decided against using the program during the subsequent year. This was the first grade in which pupils received formal instruction in grammar, and the teachers felt that the new method was not a good way to introduce this new subject. *English 2600* was, moreover, designed to cover material usually presented in a ninth-grade course, and it far exceeded in scope and depth what was customarily taught in grade 7. Indeed, the majority of the children in the experimental seventh-grade group had been unable to complete the program.

In addition, other changes in progress in the seventh grade seemed to present a very strong argument against extending the program. Some years before, the eighth grades had started using a block program in order to make possible the introduction of foreign languages and of stronger courses in science and mathematics. Now, with the introduction of foreign languages in grade 7, and of a new mathematics program in all grades from K to 12, the seventh grades were in process of shifting from the self-contained classroom to the block-period form of partial departmentalization.

The eighth-grade teachers, however, decided to use the *English 2600* program to teach English grammar and usage to all eighth-grade classes the following year. In itself, this was a very limited innovation, as the material in the program was quite similar to the material commonly taught before. But this decision resulted in a number of significant changes.

### CHANGES AND INNOVATIONS

Some changes were made to meet the needs of pupils which had become apparent during the previous year's observation. It had become clear to the teachers that children worked better on the program when they were free to call on a teacher for help with a frame that gave them trouble. Some children tended to complete sections of the program without having understood the material, and a more careful way of checking comprehension was required. Less able children needed encouragement to persist, and it was necessary for teachers to be aware of such needs, and to give tutorial help to children who had failed a test more than once. A less formal atmosphere was needed in which pupils could consult teachers and teachers could help students.

Students who even with this help were unable to answer the programed questions needed additional teaching and remedial work in a separate group.

Some students asked for permission to use odd periods between classes and time before and after school to complete frames. Others completed the program with great ease and speed, and it seemed important to provide these children with opportunities for additional intellectual learning in the time the program made available for them, instead of requiring them to mark time while others caught up.

The plan for the use of *English 2600* during the second year was influenced by these needs and also by the resources which happened to be available. There was a convenient, large room, equipped with desks enough to seat over 100 pupils; this room suggested the possibility of scheduling half an hour of the English-social studies block period of half the eighth-grade classes at the same time, so that four groups of 25 students with their teachers would be in the large room together.

Four teachers were thus available for supervision, testing, and brief individual conferences. The program books and test booklets were kept in an adjoining storage room. Since four classrooms were empty during this period, there was no administrative or academic need for retaining in the large room pupils who had completed the program.

As each child finished the program, he joined a teacher in one of the vacant classrooms. Because pupils joined groups at irregular intervals, a completely new program had to be planned. This presented teachers with an opportunity to improve another instructional area, and gave children who had completed the grammar program an opportunity to put their newly acquired knowledge to use.

For some time the teachers had wanted to expand and improve the work in creative writing. Now, as each child transferred to the small classroom, he had a conference with the teacher. The students then began to write compositions which were returned and discussed in conferences once or twice a week. The pupils soon were writing more compositions than the teachers could correct in the time available. This made it necessary to hire a lay reader, who corrected some compositions and held follow-up conferences with the children.

It had been expected that the ablest students would be the first to complete the programs and therefore the first to leave the large group. In practice, however, it was the less able students who were the first to go. These students soon found the work beyond their ability and wanted more help than was available in the large group. A remedial grammar program was started for them in one of the classrooms that was supplementing the *2600* program with class lessons and individual help. This class varied from 10 to 28 children as pupils transferred in or out. If a student completed the program in the remedial room, he was transferred to a writing class.

### PROBLEMS AND SOLUTIONS

Some of the unexpected difficulties were associated with the technical qualities of this particular program. *English 2600* is a program in book form, a programed text. Notwithstanding its cheerful blue and white cover, it looks rather formidable inside. Each page is divided into six horizontal stripes, alternately grey and white. Children liken it to a zebra. Every section, or frame, formed in this way contains a question to answer or a statement to complete. There are no diagrams or pictures, and no overviews or summaries of sections. The program covers the traditional school grammar, descriptive and prescriptive, including parts of speech, syntax, usage, and punctuation.

The student reads the first grey frame at the top of the page, writes down the answer, and turns the page. There, in front of the next frame in the series, he finds “the right answer,” usually in a single word. He checks his answer, responds to the task set in this frame, and turns the page for the next answer and the next task, pursuing the grey stripe and so repeating the procedure to the end of the book; then he returns to the front to work on the frames in the next stripe, which is white.

One cause of the trouble was that this program depends heavily on the ability of the students to read and interpret the short explanations in the frames. Although some are very simple, others require considerable sophistication, as the reading level required varies widely from frame to frame. At right, for example, are two frames from page 22. The teachers analyzed the first two sections of the program and found frames which seemed to cause their pupils trouble. One of the teachers rewrote a number of frames and devoted the summer to further work in this area. As the principal points out, however, most teachers lack the time, training, and temperament that go into making a good programer.

Some of the problems may be due to the fact that the art of adapting programs to the particular needs of schools has yet to evolve. The eighth-grade teachers soon found, for example, that the first section of a program needs to do more than teach the subject matter and method of answering the frames. It has to make clear what skills and knowledge are prerequisite to profiting from the program, so that those pupils for whom the program is too easy may be spared the waste of time, and those for whom it is too hard may be spared the discouragement of working six months without being able to complete even a moderate portion successfully.

There may be students who are incapable of learning descriptive grammar and for whom a program covering different material has to be substituted. It may even be that some students are just poor subjects for programed instruction and could be taught the same material better by other methods. The early part of a program, in any case, should

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| -er | *John is tall.*<br>*John is taller than Fred.*<br>When we speak about the tallness of one boy, we use the word *tall.* When we compare the tallness of two boys, we use the word<br>________________. |
| mother | MOTHER, FATHER, DAD, etc., show family relationship and should not be capitalized whenever they are used after A, THE, or any possessive word (MY, HIS, THEIR, BOB'S).<br>a. *Is dinner ready, Mother?*<br>b. *Their mother was not at home.*<br>Does MOTHER show relationship in sentence *a* or *b*? _____ |

separate those students able to make good independent use of the particular program from those who need help and encouragement and those who should not, for one reason or another, use the program at all.

### SECOND YEAR RESULTS

The introduction of *English 2600* led the teachers to question previously unexamined assumptions about teaching, to consider prerequisites to the study of the subject, to examine the value of teaching certain material, and to analyze the needs of students. At the same time they found themselves organizing for instruction in new ways, using large group teaching of a rather unusual kind, individual conferences once or twice a week for each child, a lay reader who also held student conferences, a class in remedial grammar, and a system of grouping homogeneously by accuracy and speed in English grammar.

The teachers also found themselves using a substantial portion of their two free periods each week for joint planning and evaluation of their program. The team, at first under the leadership of the teacher who had started the program, developed an associative relationship involving joint planning, teaching, and evaluating of the program. When the need arose, one teacher could take over any one of the eighth-grade groups, and pupils could be transferred from group to group whenever necessary. Yet no formal team-teaching structure was developed, and unlike teachers in many schools experimenting formally with team teaching, the teachers believe that their work load has not really increased. Rather, the work of planning has been transferred from home to school, and work time at school has become more concentrated.

Efforts were made to continue the evaluation of the program. In December of the second year, the Stanford Achievement Tests, for which Manhasset norms had been developed, were administered to all eighth-grade pupils. On the English usage test, pupils' average score was six-tenths of a grade level higher than in any year since the school had started testing. In 1963, the Cooperative English Test was given in grade 10 of the high school. Pupils who had participated in the first year's experiment were thus tested, but this time no differences in score were found between those pupils who had taken the *English 2600* program in grade 8, during the first year, and the pupils in the control group who had been given conventional grammar lessons.

The teachers felt that since the introduction of *English 2600* they "are making fewer red marks on the compositions." This may indicate an improvement in the students' ability to use English, or it may be related to the fact that the abler students now write more compositions than the less able, because they complete the program sooner. The marking of papers is further simplified by the practice of requiring pupils to repeat relevant sections of the program when their compositions contain errors in mechanics and usage.

The principal believes that the new cooperative planning and teaching relationship among the eighth-grade teachers is potentially the program's most important result.

### TEMAC

At about the same time as the Manhasset teachers were weighing the possibility of using *English 2600,* Manhasset was approached with the proposal to try the Encyclopaedia Britannica Films' new elementary algebra program. Neither the teachers nor the administrators were then interested, and the program was not introduced.

Some time later, the principals of the senior and junior high schools and the assistant superintendent, who by then had become very much interested in the *English 2600* program, attended a symposium on programed instruction. Professor Skinner spoke, and there was a demonstration by the Center for Programed Instruction. The administrators now felt that the potential of the Britannica's TEMAC[10] program should be explored after all, particularly for possible use with students unable to keep up with the usual pace of work in mathematics.

The school ran at that time a "decelerated" class of 24 students who were weak in mathematics and in general achievement as shown by class work and tests, but who nevertheless hoped to gain admission to college. Because these students needed the credits for college entrance, they were completing the two-year mathematics program in three years. Although the mathematics teachers opposed the use of the program, they agreed that 12 of these children be given the TEMAC elementary algebra program while the other 12 received the usual instruction. The Cooperative Algebra Test, given after the program, showed no significant differences between the two groups. The principal noted, however, that two of the children, working at their individual rates, had completed the work in algebra in one year instead of the year and a half the decelerated group normally required. They were able to join and keep up with the regular group for the geometry part of the program and so save one year's work in mathematics.

When the entire school system, K-12, changed to the new mathematics, the use of TEMAC was discontinued. The rather expensive equipment is now unused. What this episode illustrates, then, is not the effect of the introduction of programed instruction on other aspects of the school curriculum, but the reverse. These programs, consisting of a highly specific series of steps, could be adapted to changes in the subject matter only with great difficulty, if at all.

### THE THIRD YEAR

Quite a different effect of school district policy on programed instruction is illustrated by the process through which *English 2600* came to be used in grade 7 during the 1962–63 school year.

For reasons previously discussed, the teachers of this grade had consistently opposed the introduction of *English 2600*. The school district, however, joined with a group of other districts in the area to conduct joint research projects. Each district contributed a sum of money, and a committee decided on the projects which seemed to be of most interest to all participating districts. The first research project agreed on happened to be the use of *English 2600* in grade 7.

The problem in Manhasset was exacerbated by the research design proposed for the study, which called for three periods a week of independent use of the program. The students were to receive no help from the teachers, and, if they failed the test at the end of the section, they were to repeat the unit. The seventh-grade teachers were especially strongly opposed to the imposition of the program in this rigid form, since it left no latitude to the teachers. Yet the school district did not want to withdraw from the research project since no single district could with its own resources undertake what the group of school systems proposed to do, especially when it came to analysis and statistical work. Moreover, the project would have been ruined if any district could have withdrawn at any time.

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[10] Murphy, Daniel P. *TEMAC: First Year Algebra.* Chicago: Encyclopaedia Britannica Films, Inc., 1960.

Thus the program was introduced experimentally for one year. A statistical analysis for the whole experiment, involving 1900 children, was completed by December of the following year. It showed, according to Manhasset's principal, that *English 2600* is neither more nor less effective than the traditional ways of teaching grammar. Only one or two seventh-grade teachers expect to continue to teach by program, using the somewhat shorter *English 2200*.

## Present Position of Programed Materials at Manhasset

Only in the eighth grade has the interest in programed instruction remained alive, and there the *English 2600* program has developed into an important influence on the language arts curriculum. This is due in part to active encouragement by the administration over the last three years, and in part to the enthusiasm of the innovating teachers. Of the other groups whose response can help enhance or destroy the effectiveness of an innovation, the participating teachers felt that the majority of their pupils were favorably inclined toward the program, with expressed responses ranging from enthusiasm to ennui, but that their colleagues were on the whole opposed to the continuation of programed instruction. The response of parents was slight but for the most part favorable. They became acquainted with the new program through the school district's news sheet, through talks at meetings, and through reports by members of the parents' council who had been invited to visit the program in operation.

Attention from outside the school district has doubtless also had an effect on students, teachers, and perhaps the educational program itself, though this is difficult to evaluate. Visits were made by educators from neighboring school systems and from other states and countries who had heard about the innovation through references in articles, through talks given by the Manhasset staff or through the Center for Programed Instruction. The teacher who initiated the first year's program has been invited to speak to groups in Ohio and in Germany. The feeling that some colleagues opposed programed instruction was probably compensated for by the interest of visitors, whose questions and suggestions brought about stimulation and encouragement.

### THE PRINCIPAL'S VIEW

The principal of the junior high school strongly supports the use of programed instruction in his school. The basic theory, he believes, is sound, and there is a sufficient basis of research behind the application of theory to practice. The problem is to extract from the curriculum those parts which are most effectively or most economically taught by programs. It is up to the teachers to try the programs which seem promising and to find appropriate uses for them. Programs are not, of course, the solution to all educational problems, and many mediocre and bad programs will probably come onto the market while good programs and good programers will remain scarce. Nevertheless, programed instruction has large possibilities. As their fulfillment is dependent on the willingness and ability of teachers to innovate, it is important that the latter learn to work with the new materials.

### POLICY PROBLEMS

The introduction of programed instruction has raised new problems of school policy, and has made it necessary to face existing problems which have been ignored or dealt with in established but ineffective ways.

Means must be found to insure that students enroll in programs of the correct type and level of difficulty or, if necessary, in courses alternative to the program. It is necessary to determine the length of time for which students should be kept working on a program after most other students have finished, and the number of times they should repeat a section of the program and the test once they have failed the test.

Programs are much more specific and sequential than textbooks and harder to adapt to changes in subject matter. An apparently minor change in the curriculum may easily render a program useless. Curriculum policy may have to look further ahead in the selection of programs than in the selection of textbooks. Similarly, there is a danger that curriculum change may be slowed unduly by the difficulty of replacing programs unless administrators develop policies to avert this.

## Summary

The eighth-grade teachers and members of the administration are currently examining a number of new programs in the hope that they will be able to extend their use of this promising new device. But the process is slow and difficult. On the basis of their experience, they believe that they can detect the flaws of a really bad program by careful examination, but that it is impossible to pick out the really effective programs without trying them on the pupils. Thus, a few programs, including one written by Susan M. Markle,[11] have already been tried out briefly, and there are plans to try *English 3200*, a program called *Its-It's*, and a short program on the close reading of poetry which is part of an annotated anthology by Reid, Ciardi, and Perrine.[12]

From the point of view of an enthusiast for programing, the record at Manhasset is in some ways disappointing, for in three years this pioneering school has put only one program into regular use. Looking at the same record, research workers may deplore the lack of precise evidence, and administrators the lack of persuasive evidence. Teachers will regret that the experience of Manhasset offers them no assured method for finding a program that works and no problem-free way of establishing it in the classroom. Pupils will be disappointed to find that the new technique offers them no guarantee of easy and painless learning.

However, several of the innovations that were brought about by the introduction of *English 2600* in grade 8 appear to have enduring importance. Those which in the opinion of the staff have contributed most to the improvement of the children's education, individual work in composition, and cooperative planning and teaching, were not foreseen when programed instruction was introduced. The process is by no means complete, and over the next few years programs will continue to be adapted to the needs of the school, and the school environment will continue to be changed as solutions are found to current problems.

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[11] Markle, Susan M. *Words: A Programed Course in Vocabulary Development*. Chicago: Science Research Associates, 1962.

[12] Reid, James M., Ciardi, John, and Perrine, Laurence. *Poetry: A Closer Look*. Programed instruction with selected poems. New York: Harcourt, Brace and World, 1963.

# Programed Instruction in Denver

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# Programed Instruction in Denver

The extraordinary thing about the Denver story, the feature that sets it apart from the experience of most schools with programed instruction, is that Denver chose to put its main effort not on finding and buying programs, but on making its own.

Why was this decision taken? In early 1960, when Denver became interested in programed instruction, there were few if any excellent programs commercially available for elementary and secondary schools. Denver gave a thorough research trial to one of the first major programs and decided not to continue to use it. Furthermore, some of Denver's needs were rather special. For example, it became necessary to provide programs for elementary school courses in Spanish and French, the vocabulary for which had been set by the television class around which the foreign-language courses were built. When it became desirable to provide a program on the constitution, the Denver supervisors could find no commercial program on that subject that seemed to meet their needs. Therefore, in the first years of their experience with programed instruction, they were trying to make products they couldn't buy.

The result is that Denver has had three years of experience in making its own programs. This experience is worth reviewing.

## The English Programs

Denver was one of the first, perhaps the first, of the school systems in the United States to release a teacher full time to learn about programed instruction and to write programs. For the sake of history let us record that this pioneer was Jerry E. Reed, a supervising teacher of English (now supervisor of English) who, in the spring of 1960, was sent to the Collegiate School in New York to learn what he could from the work with programed instruction under way there.

The decision to send Reed to New York and to launch Denver into programed instruction had been some months in the making. Dr. Roy Hinderman, deputy superintendent of Denver schools, had heard P. Kenneth Komoski, of the Collegiate School (now president of the Center for Programed Instruction) speak on programed instruction before the American Association of School Administrators. This talk rang a bell for Hinderman because it recalled the highly effective step-by-step industrial training programs he had helped to make and administer during the war. Programed instruction sounded like an improved version of that industrial training, applied to academic subjects. Back in Denver, he discussed the new method with Dr. Kenneth Oberholtzer, superintendent, and with the curriculum committee. To these people it sounded like a good way to learn skills. In particular, they were attracted by the idea that it might help teach basic skills of English which, they felt, were being inadequately learned by present methods. Meanwhile, Mr. Lloid Jones, director of curriculum services, had visited the Collegiate School and been impressed. It was decided to select an English teacher, send him to the Collegiate School for a period of orientation, then assign him, if it still seemed like a good idea, to making some programs on basic grammatical skills. Reed was chosen, not only for ability, but – so the administrators now say – because he was *not* attracted to the idea of programed instruction. If he became sold on the method, then other teachers also might reasonably be expected to accept it.

Reed spent three weeks at the Collegiate School with Komoski, Lewis Eigen, and others, and returned to Denver to launch his brief career as a programer.

In retrospect, it seems that three mistakes may have been made in the first six months of Denver's experience with programing. For one thing, the training and experience necessary to make a competent programer, and the time needed to construct an interesting and effective program, both were underestimated. At that time Reed represented the school system's total resource in programing skill. He would be the first to admit that three weeks of observation and practice are not enough to make a skilled programer. Of course, he was able to supplement that training by reading and by working with programs. But there was all too little time for this before the summer of 1960, when six English teachers were freed of other duties and assigned to work with Reed in preparing programed materials in English.

These seven teachers worked in the classical manner by which the majority of programers have learned their craft. Together they examined the method, outlined units, wrote frames, tested them on individual students, revised, and criticized each other's work. By the end of the summer they had turned out a phenomenal amount of material – 2800 frames covering 16 units of work on English correctness: underlining and hyphen; apostrophe; semicolon; parentheses, dash, brackets, colon; quotation marks; end punctuation and commas; pronouns; prepositions; nouns; conjunctions and interjections; adjectives; adverbs; verbals; verbs; rules for spelling; sentence structure; and capitalization. When the teachers went back to their classes in the fall, these programs were still badly in need of further testing and editing. But all this had been done within six months of the time when Reed went for his brief visit to the Collegiate School.

The second mistake – it seems *now* that it may have been a mistake – was the trial of

*English 2600* just after these homemade units had been completed. *English 2600* was one of the pioneer commercial programs in the field; it covered almost exactly the same ground as Denver's homemade units, and was aimed at the same level, tenth grade. When the new program came on the market, a number of copies were given to Denver, and the schools then bought a few more so that they could give it a good test. Obviously, there was nothing wrong with this; it is the kind of activity that a school system ought to engage in when a new method becomes available. But it seems to have had two rather unfortunate results. For one thing, the introduction of the commercial program may have cooled off the impulse to finish work on the local programs. And the fact that it was introduced just at the time it was, may not have made for the friendliest possible reception of the new program by influential English teachers who had been making their own program.

A third mistake seems now to have been the decision to begin programing the parts of speech. The impact of linguistics on English teaching has been very strong in the last few years, and broad changes have been taking place. A 1960 program on the parts of speech might therefore look somewhat out of date by 1962. This is exactly what happened. In retrospect, the English teachers feel that this outdated content is the major problem with the materials they programed.

In trying out *English 2600,* Denver had help from a Stanford University research team that was engaged jointly with the Denver schools on a large project.[13] A research design was made, and the program was tested during much of the school year of 1960–61. Since this was one of the first large private tests of a commercial program, it may be interesting to look at some of the findings.

Approximately 400 tenth-grade students were used in the test. These represented all the three levels into which Denver typically divides its secondary students: accelerated classes, regular classes, and "modified" classes (meaning students who need special help in the subject). At each of these levels, approximately half the students were assigned to work on the program, and half of them to the usual classroom practice on English. Differences in ability between the experimental and control groups were taken care of by analysis of covariance. Amount of learning was measured both by a test especially made for *English 2600* and also by the California test of English achievement. Thus, the design provided for measuring the amount of learning from the program, and for comparing what was learned from the program with what was learned from conventional teaching, at each of three academic levels.

Now, of course, too much reliance should not be placed on a single comparison of a program with classroom teaching. The trouble is that it is very hard to generalize on what is being compared. What kind of teaching was being compared with the program? Denver tried to select representative teachers, but how does a representative Denver teacher compare with representative teachers elsewhere? How does classroom practice in English correctness in Denver differ from classroom practice elsewhere? It is obvious, therefore, that other schools cannot necessarily count on getting the same result when they compare a program with *their* classroom teaching.

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[13] The Denver schools and the Institute for Communication Research at Stanford were studying the context of educational television, with the aid of a research contract with the United States Office of Education, under Title VII of the National Defense Education Act. A research supervisor from Stanford, Dr. John Hayman, was in residence in Denver. The project was concerned with how to build the most effective combinations of teaching and learning activities around a master teacher, presented on television, to teach Spanish language in the elementary schools. At that time, of course, few elementary school teachers were experienced in teaching foreign language.

Nevertheless, the experiment was carefully and cleanly done, and the results were interesting. In the first place, there was a great deal of learning from the program. Over-all, the students who studied the program learned as much (when measured either by the California or the *2600* test) as the students who had class practice. But the more interesting findings had to do with different performances by the different ability groups.

The accelerated classes learned significantly more from the program than from conventional practice. On the other hand, the accelerated students were the ones who complained most about the program. Some of them were bored with the repetition. Two thirds of their written comments, however, had to do with frames they felt were confusing and answers with which they did not agree.

The regular classes did about as well with the program as with class practice. But the modified classes did significantly better with classroom practice than with the program.

Why should these differences be? Was it because the better students adapt more quickly to new methods, or like to work at their own pace? Do the slower students adapt less quickly? Do they have trouble with the program because they are not very good readers, or because a teacher can fit practice to their special needs better than a program can? These were some of the conjectures made by the Denver people. They found the results in some respects surprising, because they had rather expected the program to narrow the difference between the faster and slower students – in the belief that everybody, at his own rate, would learn most of what the program had to teach. Actually, the differences were considerable. On the California test the means for the three groups (adjusted by covariance) were 75, 70, and 64, respectively. The accelerated students progressed at an average rate of about 273 frames per hour, the regular students at 233, the modified students at 185. The error rate for the slower classes was more than *three times* that of the accelerated students – 6.5 as compared to 2 per cent. (Of course, much of the content of *English 2600* was already familiar to the accelerated students.)

The Denver people passed on these results, along with a number of comments on unsatisfactory frames, to the publishers of *English 2600,* and on the basis of these and other findings the publishers did decide to revise the next edition. The English teachers, however, were not satisfied with the amount of revisions made and decided not to continue with the program. The spotlight, therefore, shifted back to the 2800 homemade frames.

In the summer of 1961, Reed gathered the best writers from the previous summer for more work on the English programs. They made some revisions in the programs, and developed short booklets to help students overcome errors they identified by keeping records on an error grid. (The grid is an ingenious device which permitted teachers and students to recognize the kinds of errors being made, and is, of course, useful with or without a programed text.) Mimeographed in booklets, the sixteen programed units were then offered on a voluntary basis to all English teachers at the appropriate levels.

At this time, Denver was still learning how to introduce programed instruction to classrooms. The new English materials were introduced in this way: first, they were discussed with the English Curriculum Committee, which consisted of a teacher representing each building. The English supervisor explained the new method and the books. The building representatives were then expected to do the same for other English teachers in their buildings. This was less than fully successful. As a result, the programs were used in many different ways.

This variety might have been helpful, if there had been arrangements for systematic feedback from the classrooms. Really very little hard evidence turned up. A small experiment was done comparing a group (A) which merely read a programed booklet on "End Punctuation and Commas," with a second group (B) which kept track of its errors on the error grid and then studied the parts of the program which corresponded to the chief errors, with a third group (C) which kept track of its errors and then studied appropriate rules and examples. The first time this experiment was done, group B did notably the best work. When the experiment was repeated, however, this result could not be confirmed; there was little difference between B and C.

The English booklets are still available for use in all seventh- and eighth-grade English classes, but are not widely used. One place where they are used and muchly appreciated is in the Opportunity (adult) School, where students enter at any time in the year, and can be given programs and allowed to progress at their own pace. But the programs have not been given the further editing they badly need, and there is still no very systematic evidence on their effectiveness. As Reed says, after three years some of the content is out-of-date because the linguistic approach to teaching English has changed. He and his colleagues do not want to perpetuate outdated grammatical principles by programs or any other means; and the necessary revision of the 1960–61 materials would therefore have to be a major one.

## The Spanish Program

In its second major entry into programing, Denver was able to learn from its experience with the English programs. This time it assigned an able young teacher of Spanish, Del Barcus (who has since assumed primary responsibility for all programing in Denver), full time to constructing a sixth-grade Spanish program. This was a part of the Denver-Stanford research project. One aspect of the "context" of instructional television was to be a program that would speed the transition from the wholly audio-lingual method of teaching, which the students had experienced up to the sixth grade, to a combination of speaking-listening and reading-writing. The program was therefore concerned with the skills of word recognition, reading, and writing, and the vocabulary was set by the television teaching. There was no program in existence to meet these needs; it was necessary to make one.

The really significant difference between the making of the Spanish program and the making of the English units was the amount of time assigned to it, and the fact that one individual was given the task. Reed had been given some time in the spring, and then he and a number of others were given the summer to write. This meant that a number of fairly inexperienced persons were doing the work. Barcus, however, was given two full years, full time, to learn the method, write and test his program, and see it into use. Perhaps this amount of time could not have been freed, were it not for the research project, but it *was* freed, and the results were good.

Barcus consulted with Dr. Arthur Lumsdaine, of UCLA, and members of the Stanford team. He started rather slowly, reading a great deal about programed instruction, examining some programs, trying his hand at writing frames. Several times he sent units of the program to the Center for Programed Instruction, where they were helpfully criticized. Mostly he worked along in the classical way: writing, testing on a single student, revising, testing again, until the unit was ready to try on a class. Revised again, it was given a pilot test in a number of classes. This was a painstaking procedure, but, as Barcus said, it resulted in a program that "worked."

Some people at Denver were a bit surprised how long it took to write the program. Barcus worked through 1960–61 and much of 1961–62, before he had developed and thoroughly tested the amount of material which the course seemed to need. Credit it to the good sense of the Denver administration, and the good fortune of a research grant, that he was given this much time.

The Spanish program was introduced more carefully than the English programs had been. Teachers who were to use the sixth-grade programs were paid to come to a series of Saturday morning workshops. They had a chance to work through parts of the program, discuss the use of programs, hear some speakers, and in general deepen their understanding of and coordinate their plans for using programed instruction. The extra time used to introduce the teachers to the method and the program to the teachers, paid off. There was no resistance to speak of, and, indeed, as soon as the program went into use, teachers began to ask for more like it. It soon became apparent that the Spanish program was a success, at least with the teachers.

What did it accomplish with the students? In this second venture, thanks to the research project, Denver was able to get detailed and systematic feedback. It is not possible here to describe completely the results of these tests, which involved more than 6000 students, but let us at least record some of the results that were interesting to the Denver people.

In the first place, as was expected, the students learned less from the program studied by itself than from a corresponding amount of time devoted to drill by a competent teacher. This was not surprising. Throughout their NDEA experiment, Denver had been finding that an experienced and motivated classroom teacher was the best single "teaching aid" they could add to television. In fact, the general finding had been that if any of the classroom time was taken away from the teacher and used for some individual practice by students, the over-all performance of the class went down. But when the new program was used for *part* of the classroom time, the amount of learning was substantially raised. In other words, with time held constant, the program *plus* classroom teaching was more effective than either alone.

There is obviously an important relationship between teacher and program. One of the most interesting findings of the experiment was that the more interested, the more highly motivated, the teacher, the better work the students did on the program even though they worked privately. The interest and inspiration of the teacher carried over to the individual and private work done by the student! This underlined the wisdom of giving teachers a thorough introduction to programs before introducing the method.

Another finding of interest was that there appears to be an optimum time to introduce such a program as this one. In the first semester of the sixth grade many of the students were not yet enough at home with the language to make best use of the program. They had not yet sufficiently absorbed the skills of listening and speaking. Introduced in the second semester, the program worked much faster and better.

A comparison between program use at home and in class showed, contrary to expectations, that there was more learning when the program was used in class than at home. It had been generally thought that programs would make efficient and systematic homework, freeing the class time for other learning experiences. Two possible explanations of the contrary result were suggested: that the students were simply not doing their homework carefully, or that, because they could work at their own pace at home, the class was not together at school, and therefore the class time was spent less efficiently. With programs that are being used as homework, Denver teachers now frequently give five-minute quizzes the next day. The teachers feel these help.

Many more findings came out of the research, but the important thing was that, both in the *F* and *t* ratios of research and the less specific opinions of the teachers and the students, the program was a success. Teachers reported back enthusiastically. "This is what we need," they would say. "When can we have more?" A minimum of boredom was reported of the students using the program. When six excellent teachers were given the opportunity to teach the course in their own way, using whatever combinations of materials and methods they thought would teach their students most, every one of them chose to use the program. This year it is in use throughout the sixth grade.

## Third Generation Programs

Having tried one method in making the English programs, and another with the Spanish, Denver understandably chose to make the next major programs in the way that worked so well with the Spanish materials. When a program was needed for elementary-school French, a teacher was assigned full time to write it. It is still in the stage of writing and revising, and is expected to have its first large scale test in 1964.

A programed introduction to the constitution was also felt to be needed. A teacher was assigned full time to this, under the guidance of Jack Pottle, supervising teacher of social studies, and the program is now in pilot-test with 21 classes. First reports are very favorable.

The year 1962–63 was something of a turning point in the history of Denver's use of programs. Up until then all ventures in programing had been initiated by administrators. In 1962, however, with the Spanish program proving successful and with at least elementary knowledge of programed instruction beginning to permeate the teaching staff, some pressure for programs began to come from teachers. For example, the teachers in the elementary English curriculum asked why no English programs were being written for elementary school. A start is now being made at preparing materials for that level. One elementary school program was made by a teacher, on his own time. He tape-recorded a program on the multiplication tables. This is reported to be popular and effective with children in the early grades.

In addition to these homemade programs, a few commercial programs are now being used. These are mostly short units, aimed at remedial tasks. Certain schools are using the California series of basic skills programs. Two CHEM study programs – *Use of the Slide Rule,* and *Working with Exponents* – are used in a number of schools. Teachers seem grateful to be able to turn over some of their drill and remedial responsibilities to programs like these.

The important thing is, though, that *teachers* are beginning to ask for programs, and a few of them are even taking steps toward making programs. This is a considerable change since 1960. There was no discernible teacher pressure for programs when Reed was working on his English "2800." At that time all pressure was from top administration. There was no firm resistance, even at that early time, but neither was there great enthusiasm, until the Spanish program became available. What has happened in 1962 and 1963, therefore, is notable: real enthusiasm for a few programs, suggestions from teachers that programs be prepared for *them,* schools ordering programs for some specialized and remedial teaching, and a teacher working on his own time to produce a program on tape. It was not always thus!

Another favorable sign is that in 1963 the superintendent appointed Barcus a supervising teacher with responsibility for programed instruction, indicating that the administrators are encouraged by what they have seen.

## What Has Been Learned?

### THE TIME DIMENSION

After three and a half years, therefore, Denver has one major program successfully in use, two more in pilot-test or soon to be pilot-tested, a considerable amount of programed material in English, sporadically in use but not yet in final form, and a number of programed units, some commercial, some homemade, in use here and there. This is respectable progress, but not quite what observers were predicting five years ago. In Denver, programed instruction hasn't exactly "gone like wildfire."

Looking back over their experience, the Denver people who have been closest to the developments in programed instruction are inclined to think that one of the most significant lessons they have learned is about time. Introducing programs is a slow business. It takes far more time than they had expected to write a good program. The chief difference between what happened to the English materials and what happened to the Spanish materials is the amount of consecutive time the schools were able to make available to any one individual assigned to either program: in the case of the English, a few months; in the case of the Spanish, two years. The skill of writing programs is apparently a slow acquisition, and the task of testing and revising programs is slow drudgery. But the task of *selecting* programs is also a slow one. The Denver people agree with the increasingly held belief that a school cannot be certain of a program without testing it on students. Their advice to a school considering the purchase of some programs is first to find out as much as possible about the principles of programed instruction. If there is no person in the school system informed on this subject, the school might well bring in an expert for a few days. The next step is to select what looks like a good program and try it out; have a few teachers work through the program, noticing both the substance and the method. If the program passes that test, then give it to a teacher who likes programed instruction and have him try it out in a class. Only then can the school be fairly confident about its choice. And this is a slow business. It is slower, for example, than choosing a new textbook.

### TESTING

The importance of testing programs is another lesson Denver feels it has learned. The individual testing that goes into the making of programs is taken for granted. But the pilot tests are useful, too. No small part of the confidence the teachers and supervisors feel in the Spanish program comes from the careful and highly successful testing it has had in classes. The Constitution program will benefit from its pilot test, and so presumably will the French program. Closure on the English materials will never be arrived at until they have been prepared for and given a similarly thorough testing.

### INTRODUCING A PROGRAM

The problem of introducing a program has concerned the people in Denver, because if it is done well, it too is a time-taking and expensive process. The best way to introduce a teacher to programed instruction, they agree, is to give the teacher an opportunity to write a short program and test it on a few students individually. This may be worth what it costs, simply as a learning experience for the teacher, but as a method of orientation it is probably too expensive to be used generally. The next best method, they feel, is to have a teacher work through a program – either a program to be used in class, or a program on programing, like the Markle *Programed Primer*.[14] When time was available, the Denver orientation sessions have included a general introduction to programed instruction, a chance to work through most or all of a program, and discussion on classroom use of the program. As teachers become more sophisticated with programed instruction, less time will be needed for orientation; but at first, a good orientation may be crucial.

### RESULTING CHANGES

The Denver experience with programing has not been as dramatic or exciting as people have sometimes expected the use of programs to be. The programs themselves are fairly orthodox linear types, although less restricted than many other linear programs. Someone has said they are "teachers' programs, rather than psychologists' programs." The Constitution program, for example, mixes orthodox items like:

> The power to call
> a special session
> of Congress rests
> with the ________ . . . (President)

with more customary classroom questions:

> What is a treaty? . (an agreement with
> a foreign nation)

This and the Spanish program both run along more like dialogues with the teacher than like conditioning exercises. The writers do what classroom teachers would do, referring frequently to panels or visuals, turning aside to give the student a little coaching, and so forth. They approximate a pleasant, low pressure tutorial session.

Use of the programs in class has not yet made any great difference in school procedures. No students are on an "individual progress" plan; no courses have been turned entirely over to programed instruction. Rather, the programs have been put firmly under the control of the teacher, and are being used, like any other learning aid, where the teacher thinks they belong. The changes are not dramatic, but they can be felt nevertheless. The fact that a mathematics teacher can depend on a program to teach his students to use the slide rule, that a fourth-grade teacher can count on a program to teach his students correct spelling of homonyms, and that a third-grade teacher can use a programed tape to drill his students on the table of fives – these represent a significant wave of change. The teacher is being given a set of proven assistants who can take over some of his more routine duties. In Denver the program is thought of as a part of a teaching team, headed by the classroom teacher. The teacher is not being "replaced"; he is being given an assistant, more reliable than most assistants because one knows exactly what he can do and always where he is. This obviously takes away a great deal of the teacher's anxiety over programs, and raises the incentive to become familiar with the program and expert in its use.

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[14] Susan M. Markle *et al. A Programed Primer on Programing.* New York: Center for Programed Instruction, Inc., 1961.

Some of the results of this low-pressure approach have been quite dramatic. A teaching "team" has been created to teach Spanish in the elementary schools, where, at least until recently, there have been so few teachers qualified to teach foreign language. This team has included a master teacher who presents two or three classes a week on television; the classroom teacher; certain co-operation from parents (after 50 years in which the school has taken over more and more responsibility from the parents, the parents are being brought back into the picture!); the program used at its appropriate point, and so forth. All these and others work together in such combinations as are best for given students and given situations. This kind of team has considerably increased the amount of learning from the course. It should be pointed out that this is a considerably different approach from that of a number of the best-known writers on programed instruction. It is in no sense an effort to turn over the major teaching to a program – to "get the teachers out of the way of the student," as some have suggested – but rather an effort to find the job that a program can best do, under the guidance of a teacher who is responsible for combining the learning experiences at her disposal.

### SECOND THOUGHTS ON MAKING PROGRAMS

As the men in Denver who are chiefly responsible for programed instruction look back over three and a half years of experience, are they sorry that they made the decision to construct their own programs? No, not really. It was a choice they could hardly avoid, given the kinds of program they wanted. But on the other hand, they do not believe it will be feasible in the future for a school system to make all or even most of its programs.

They say this even though they have been quite critical of many commercial programs. Many of these, they say, "ignore empirically sound elements of teaching – variety, interesting writing, effective visuals, a preliminary overview." Some show "the programer's weak background in subject matter." Some display "lack of contact with the research in the subject matter field." Some display – we are still quoting –"blind faith in a stereotyped form of programing." And most of them don't come within research evidence that would help a teacher decide whether the program can really teach or not.

Despite these reactions to many early programs, the Denver people think the majority of programs used by schools in the future will come from the commercial publishers. They point to the cost of releasing a teacher full time for a year or more to make a program. They say, furthermore, that it is often difficult to find, among one's teachers, a really good programer. Many of the ablest teachers don't want to devote a year to writing frames. Even if the teachers are willing, it is sometimes hard to tell who will make a good programer. Denver has by no means always been so fortunate in selecting its programers as it was with the Spanish program. The teacher who finally wrote the Constitution program was not the first who tried it; and some of the

English programers were better than others. Given enough time and money to find the right teacher, releasing him full time for long enough to learn the method and prepare a program that satisfies him and tests well with students, the Denver people have no doubt that they can produce excellent programs tailor-made for the school system. But how many programs can a school afford to make that way? An additional item of cost and difficulty is the need of really systematic testing. Many school systems do not have research departments to do this. Therefore, although the Denver people do not regret their own decision, they feel that the major responsibility for producing school programs in the future will be with commercial publishers, who can program for larger audiences and spread the cost.

Even though commercial programs will get a lion's share of the business in the future, the Denver people believe it would still be desirable to have a certain amount of local production. Looking at their own experience, they feel it is a very salutary thing for a teacher to do a little program writing, even though he may never become a good programer. Not only does he become better able to use programs in his own classes, but he also acquires certain habits and methods which are applicable to many kinds of teaching. Ideally, all teaching materials should, like programs, be tested item by item on individuals and groups. Ideally, all teachers should frame specific objectives and develop evaluative instruments to measure them, as must be done for programs. Ideally, all students should have their school experience so arranged as to involve them actively and continually in their class work; and they should be given a number of success experiences, and receive quick confirmation of correct procedures. We have been paraphrasing the words of the Denver people who have been closest to programed instruction. Their point is that if a school encourages a certain amount of local production of programs (even though it depends on the commercial market for most of its materials), then it will acquire at least a few superior programs tailored to its own needs, and, far more important, the principles of programing will tend to spill over and improve all teaching and all teaching materials.

# Experiences with Programed Materials in the Chicago Area

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# Experiences with Programed Materials in the Chicago Area

## General Reactions

In order to seek opinions about experiences with programed materials we had first to locate persons who had used them. A questionnaire was sent to 104 representative school systems on the mailing list of the "Administrator's Notebook," published by the Department of Education at the University of Chicago. Thirty-six responses were received, and among these 24 stated that programed materials had been tried in their system. Fourteen of these indicated that continued use of such materials was planned. We shall begin our report by examining the sketchy questionnaire data to see what factors distinguish the schools who considered their experience with programed materials successful from those who considered it unsuccessful or not satisfying.

Next we shall examine interviews with eight teachers, equally divided in their opinions as to whether programed materials, as they experienced them in their classrooms, are or can be educationally sound. Finally, we shall pull together both kinds of information – from schools and teachers – and try to relate the experiences to principles of teaching and learning with which we have been concerned for some time.

### POPULATION AND RESPONSES

The population canvassed by questionnaire included urban, suburban and rural school systems which served students in the conventional 12 grades as well as a few adults in continuing education. Ninety of these systems were in Illinois and 14 were in Indiana.

Responses were received from 36 of the school systems, and this sample represented the same range of systems, grade levels, and sizes. No actual check was made on the randomness of the sample; therefore, all generalizations are limited to the sample.

Twelve responses stated that no use had yet been made of programed materials. The reasons could be listed in four categories as follows:

The first category consisted of replies which suggested no particular reason, or gave a vague reason for not using programed materials. One example is the response: "Various areas are studying the available materials and procedures and it is hoped that, in the not too distant future, some materials will be in use in this system."

Several negative responses were rejections of programed materials, as the following examples will show. "Programed teaching has little use in art because creativity in art must be spontaneous and ever changing," said one department chairman, rejecting the materials on theoretical grounds. "There is no evidence proving superiority over the traditional 'good teacher-class' relationship," said a superintendent, rejecting programs on the basis of research findings. Another category of rejection is suggested by the statement: "high cost is also an important factor in making the use of such materials impractical in our classes."

Many persons commented on the unavailability of materials for several instructional areas and the "unsuitability" of some that were available, giving these factors as reasons for non-use.

Finally, some were not using programed materials because they were still selecting and preparing for such use. Respondents in this category indicated plans for the use of some materials during the 1963–64 school year.

Many school systems reported a variety of uses which are summarized in Table 1. In that table "use" was categorized as "casual" on the basis of such statements as "Our system is not using programed materials at present with the exception of a few cases. There are some students in first-year algebra at our junior high school using TEMAC materials." The listing "systematic" was reserved for programatic use for a described category of students or subjects, thus: "SRA materials are being used with boys and girls who have been identified as needing additional help in reading or who on their own initiative desire to improve." The classification "experimental" was not included in the table because it contains situations where data, such as pre- and post-test scores, were systematically collected; such situations, however, are reported briefly on page 45.

The grade levels at which programed materials were used followed rough patterns, according to the subject matter or skill area involved. Programs in mathematics were the exception, with use reported from the elementary school through adult education. Materials in English, usually specified as "grammar" or "language usage," were used in grades above the sixth. Reading programs were not reported used above grade 8. Science programs were not reported in use below the junior high-school level, and so on. Two entries in Table 1 are "unspecified." One of these respondents said: "We have used the TEMAC materials developed for grades 9 through 12 in our summer school with great success." The other stated that "some programed materials are being used in dealing with some remedial students."

The materials specifically mentioned at least once in the situations in Table 1 are: *English 2600*, SRA *Algebra*, U.S. Industries' *Computer Mathematics*, TEMAC *Algebra I*, Harcourt, Brace and World's *Mathematics Enrichment Program*, SRA's *Microscope* and *Reading Laboratory*, the EDL *Study Skills Library*, and unspecified materials from Grolier and Coronet.

TABLE 1

Nonexperimental Use of Programed Materials Reported in 40 Situations from 24 School Systems Indicating Recent Use

| Use Reported | Plan to Continue Use | | | |
|---|---|---|---|---|
| | Yes | Probably | No | No Indication |
| [CASUAL] | | | | |
| English | 1 | | 1 | 3 |
| Industrial Arts | | | 1 | |
| Mathematics | 3 | 2 | | 1 |
| Reading | 1 | | | |
| Science | 1 | 1 | | |
| Unspecified | | | | 1 |
| [SYSTEMATIC] | | | | |
| English | 5 | 1 | 2 | 2 |
| Mathematics | 4 | 3 | 2 | |
| Reading | 2 | | | |
| Science | 1 | | | |
| Study Skills | 1 | | | |
| Unspecified | 1 | | | |

One thing is apparent from Table 1: The systematic use of programed materials seems to lead to a clearer decision about whether or not to continue its use. Only two out of 24, or about 8 per cent of the systematic users, gave no indication of future intent as opposed to five out of 16, or about 31 per cent of the casual users. Further, approximately 58 per cent of the systematic users, as contrasted with 38 per cent of casual users, said "yes," they intended to continue using programed materials. Grade levels, though not indicated in the table, failed to reveal patterns differentiating the plans for continued use of the systematic as opposed to the casual users.

A more useful insight into the use of programed materials is gained by scrutinizing the reports of how, exactly, they were used. Twenty-seven reports either mentioned or implied that use was to be continued in that situation. These 27 reports contained four distinct patterns of use: 1) "self-contained" instruction as recommended by publishers, 2) remedial instruction, with a variety of assistance from teachers, 3) enrichment, meaning either to permit wider exploration of ideas or allowing gifted students to move deeper into advanced ideas, and 4) aids to regular classroom instruction, used as reference or supplementary material at particular places in a regular course.

None of the casual users employed the material as self-contained instruction but two of the systematic users did. An additional three systematic users may have, but they left the issue unclear. For example, one response so classified had the following remark listed as an advantage: "more individual help." Thus, one cannot be certain about three of the instances classified as "regular instruction."

Similarly, six systematic users employed programs as aids to classroom instruction, while no casual users reported such employment. The same was nearly true for remedial instruction; over half a dozen systematic users were classified here but only one casual user. In the enrichment category we find seven casual users and no systematic users. (The reader is reminded that we have been analyzing those situations where use of programed materials was to be continued.)

In general this set of patterns shows one thing clearly: *programed materials were seldom used as the regular instruction in classrooms.*

The following quotations from persons who found satisfaction in using programed materials and plan to continue their use will attest to this fact:

"The advantages for this type of materials are that it is something to which children who are looking for additional information may be referred, and something they can work on with a minimum of supervision."

:

"Our special reading teacher works with small groups in reading and up to about 25 students in the study methods course (where the materials are used). She has the help of two other teachers in the study methods course, and these boys and girls receive considerable individual attention and evaluation of the work they are doing."

:

"If properly used, they can be a valuable supplement to a (high-school mathematics) teacher in the classroom."

:

"She used these texts, intended for 9th grade, successfully at the remedial junior level . . . As a text, however, their scrambled nature virtually prohibits their use as a reference book during writing sessions."

:

"In both chemistry and biology we have used the programed materials in the format of books, which individual students can work at to recover from absences from class or from poorly understood class instructions."

Boredom was a subject mentioned often in the reports received. Even the six reports that indicated definite plans to continue use of programed materials stated that students became bored by the materials. This was reported about regular classes as well as about "individual students of exceptional ability" who became "bored with the too easy development of ideas, concepts and vocabulary." Boredom and other reactions of students seem to depend both on the nature of programs and the conditions under which they are used. The fuller case studies, presented in the second half of this report, suggest that programs used by themselves, without enrichment or other activities, may be especially likely to induce boredom.

### EXPERIMENTAL SITUATIONS

The ten experimental situations covered a wide range of grade levels and subject matter or skill areas, but only one was at the high school level. The subject matter was English grammar in grade 10, and 58 pupils, divided into two classes, were involved. English grammar was also involved in an experiment at the seventh- and eighth-grade levels. Four experimental classes with a total of 100 students participated. At the seventh-grade level two experiments in mathematics were reported. One involved a total of 20 students in four groups, the other involved a "slow group." Mathematics was also the focus of an experiment in the sixth grade. Eighteen "top students" participated. At the fifth-grade level there were experiments in science, geography, study skills and mathematics. In each instance two classes with a total of 60 students participated. Finally, one experiment in reading in the first grade was reported; four groups with a total of 30 students were involved there. Three of these experiments are reported here with some details.

The first experiment dealt with sophomore students in a high school. *English 2600* was the material under investigation. Three groups of students were involved, "two experimental, using programed textbooks, and one control group using the conventional lecture-recitation method with the standard Row-Peterson *Building Better English*, grade 10 textbook." The experiment "lasted a little more than six weeks. The results of the *2600* program showed that students in the program improved considerably throughout the program."

Briefly, the specific results with regard to achievement were the following: "The first and seventh hour classes (both of whom used the *2600* program) showed a +11 and +8 point difference, respectively, between the pretest and post-test scores. The fifth hour control group showed only a +4 point improvement. Some of the individual students working with the programed instruction improved over 20 points from pretest to post-test. The greatest improvement was a total of 30 points from pretest to post-test. This improvement is the equivalent of a student improving from a D— to a B+ grade. Of the approximately sixty students taking the *2600* program only four students failed to show any improvement."

One wishes that a more rigorous test of the reliability of the gains, or of the differences in gains, were available for the above study. Fortunately, another experiment involving the same materials provides some of the desired rigor and does help in interpreting the previous study.

The second study involved students at a different grade level than the first. "The purpose of this study was to utilize programed teaching as a method of instruction in English grammar and usage and to observe whether the mechanical functions of the teacher's assignment might be reduced without affecting the quality and content of the material presented to students. . . Two experimental classes were selected at each of two grade levels (7 and 8) for purposes of the study. Class groups to serve as controls during the period of the study were also selected in equal number from the seventh and eighth grades. The experimental and control groups each received a pretest, recall test and a delayed recall test. The delayed recall test was given to all participants four weeks after the immediate recall test."

Care was taken to randomize students among all groups. There were 100 seventh and 101 eighth graders, with the numbers in the experimental and control groups "balanced." Preparations for the experiment included a series of meetings of teachers and an orientation for all participants in the experimental groups "to insure that the participants received the same basic information." A detailed schedule of instruction and testing was followed. The instructional period opened with the first pretest on September 25 and closed with the last post-test on November 22. The delayed recall test was administered between December 18 and 20. Further, "the final examination prepared for use with *English 2600* was used for the pretest, immediate recall and delayed recall test information." The results were summarized as follows:

"From the pretest to the immediate recall test the difference between mean gains was in favor of the seventh grade experimental group at the 5 per cent level of confidence. The *t* score for this group was 1.70. Although the mean gains for the eighth grade were in favor of the experimental group between the pretest and immediate recall test, the results were not statistically significant at the 5 per cent level of confidence. The difference between the means of the two groups from pretest to delayed recall testing was not significant at the 5 per cent level of confidence."

Further analyses of the gains for groups defined by ranges of IQ were reported. In general the group with IQ's below 111 made the poorest showing, forgetting the most between post-test and delayed test in the seventh grade, and making the smallest gain from pretest to delayed test in the eighth grade. The other groups were defined as having IQ's between 111-125, and over 125.

The report of this experiment concludes with the following statement:

"It must be recognized that this investigation was a field study to observe the influence of programed material. Further, although basically designed for ninth-grade use, the course content was utilized at the seventh- and eighth-grade levels with heterogeneous class groups. No attempt was made to modify the program or to interpret the criterion of performance in terms of error rate, framing or programing techniques. These conclusions, nevertheless, would seem to support the theory that adequately programed courses could produce satisfactory performance factors."

The most interesting fact in this experiment is that the seventh graders in the experimental groups registered losses in score between the post-test and the delayed test while the eighth graders in the experimental group registered gains for the same period. Again, this leads us to conclude that what the teacher does with the students is extremely important to the success or failure of programed materials. Surely, the seventh and eighth graders must have received differential instruction following the experiment for these results to obtain.

Comparing this study with the first one reported, it is clear that the gains reported in the earlier one are well within the limits of the gains in the latter. This adds confidence to the interpretation of the first study.

The third experiment to be reported was of a different nature. Here achievement and rate of work were studied, using content from mathematics. The report states:

"We used this material with a class of our 18 top sixth-grade students. We took ten 40-minute meetings to cover Program A. The students worked at their own rate of speed and took a test when they were ready for it. I was in the room at all times to answer individual questions for them. We spent the last ten minutes of each period for group discussion. All the work was done during the class sessions.

"The tests used for evaluation were those listed in the accompanying teacher's manual . . . There were five tests in Program A and the average time spent in preparing for each test and the average per cent grade . . . for the first eight students who finished the book are as follows. . . ."

These eight students are listed according to the average time spent preparing for the five lists. Student A, the first in the list, spent an average of 30.0 (minutes, apparently) preparing for the tests, and received an average grade of 98.8 per cent on the tests. Student H, eighth on the list, spent an average of 61.8 minutes and received an average grade of 97.6 per cent. In view of the fact that the subjects were "our 18 top sixth graders" and that the average time spent in preparation for each test was extended from one-half hour to one full hour over just "the first eight students who finished the book," one wonders how long it took the eighteenth "top" student to finish. These eight students clearly accomplished the goal usually set by theoreticians and programers, i.e., they achieved a minimum score of about 95 per cent on the tests.

How the students felt about programed instruction may be determined from five comments that were typical of their reaction: "I think it did me no good at all. It was boring and a waste of time. It was easy and should not be used." | "This programed instruction book seemed quite boring but it helped me learn new vocabulary such as 'null' and 'straight-edge.' " | "I thought that his book wasn't very good learning material. You learned so little in so long a time. It got quite boring after a while." | "I think that the going was slow and boring. I did learn something but I could have learned the stuff just as thoroughly if you spent half the time on the concepts." | "I thought this was a little too easy for our level. I learned something but for the time I spent on it, it seemed unnecessary."

The author of the report continues by saying that he realized at the beginning of this experiment "that the content would be easy for the students. The experiment was conducted to determine student reactions from a controlled programed instructional program and to see how achievement would vary with rate of work . . . The question that we must yet answer is: can we obtain content that is challenging to our superior students and yet written in such a fashion that the error rate is less than 5 per cent? Further work is needed to answer this question."

One cannot be certain whether or not the five comments were from the eight students who finished first. However, the comments are not new, regardless of the source.

The remaining seven experiments had been completed so recently that the data had been examined but not fully analyzed. Six of them were undertaken in the same school district, one in grade 1, four in grade 5, and one in grade 7. Here are the tentative conclusions based on less than a rigorous analysis.

"We are now in the process of summarizing the data collected. On the basis of a cursory look at the data, we are planning to continue the use of some of the programed material, to eliminate a number of programs which have not proved satisfactory, and to evaluate some additional material recently published. . . .

"We have found that short programs dealing with a specific area of the curriculum can be utilized to advantage with an entire class. The great advantage is the ease with which individual students or groups of students can pursue a specific content area with little direction from the teacher. We can see the programed material being used as an additional instructional tool by the teacher, assisting her in her classroom task."

This analysis of the questionnaires leads us to say that some programed materials can be used successfully and to advantage with some pupils, for some limited or specific purposes. Assertions involving terms such as "every child," "motivation," or "high achievement," and implications that programed materials are self-sufficient, especially for large sections of a course, should be viewed as somewhat hyperbolic. It remains to be seen whether our conclusions still seem warranted after a look at the additional information below.

## Teachers' Experiences

We interviewed eight teachers who had used published programed materials for the major part of a year. Four of these teachers were, in general, thoroughly disillusioned by their experience; the other four were quite satisfied. The first four used the programs as *completely self-contained*, with help given to individuals by the teacher. One of these four teachers had a volunteer class of superior students in statistics; the other three taught algebra and geometry, as required subjects, to more or less normal classes.

The second group of four teachers used work on programs *as part of the instructional activities* in a high-school electric shop, in sixth-grade spelling, fourth-grade multiplication, and eighth-grade algebra.

The first generalization that can be made, which fits practically all the data from the eight teachers, is that *programs used by themselves are simply inadequate educational materials; but that short programed units, planned within sequences of a variety of in-*

*structional activities, may be quite useful.* But there is more to be said, so let us now turn to the interviews with these eight teachers.

### COURSE IN STATISTICS

The students in this course were high-school seniors who had volunteered for the course, and came in to work on it during their study periods. Most came for three periods a week, but a few came for five periods.

The course consisted of going through the program, receiving help from the teacher when and if a student asked for it, and taking tests devised by the teacher at the completion of each chapter or unit in the program. There were no other activities in the course. The students finished the program quite rapidly, and asked for very little assistance.

In the opinon of the teacher, however, they were hampered by the fact that the program (put through a machine) could not be turned back and they could not easily refer to previous answers. The teacher felt that this was an unnecessary restriction, and that the book-type program with movable mask is preferable to the loose-leaf program put through the "machine." Another restrictive condition was the fact that the window through which problems and derivations are presented was so small that any lengthy derivation became too cramped: "You need a microscope to see the text." Similarly, the answer space was too small for anything but the shortest answers.

The students were helped by getting the answers right away (feedback). The teacher also felt that the gadgetry and novelty of the program was a positive factor.

In spite of the students' apparent competence in going through the program with little help, two things happened that turned the teacher against self-contained programed instruction: first, the students had lost most of their interest in the course by the end of three weeks (or approximately ten sessions), and soon thereafter half of them simply dropped out. Second, in spite of apparently successful performance on the program, the students did very badly on the teacher's tests. The students were able to play the game with the program, but the teacher felt that they learned very little statistics.

In an effort to account for the lack of learning, the teacher first considered the curricular validity of his tests – had the students had the opportunity to learn what the tests measured? His answer was that he had made them up directly from the material in the program; he considered them "fair" in that a student who really understood the material should have been able to answer the questions.

What about the format and the presentation of the program? How sound were the instructional principles on which the program had been constructed? The teacher pondered two aspects of this question: how well was the program *adapted* to the students' capabilities and interests and how well did it *develop* understandings of the sort he was seeking?

The teacher felt that the program made "very little use of the students' superior mathematical background," and that it failed to apply concepts and principles through which the ideas could have become more interesting and meaningful. These deficiencies could well contribute both to boredom and to lack of learning of principles. With regard to the development of understanding, the teacher concluded that going through the sequence of short steps cannot "give the student . . . the whole picture"; that is, students fail to see the larger framework of concepts and principles within which the specific parts (i.e., the frames) add up. The students might learn the words and formulas presented in the frames (i.e., "increase their verbal repertoire"), but they fail to see (or learn) how to use the ideas the words represent as instruments to solve some of the problems.

This teacher was most ingenious in thinking up ways to make the statistics program more effective. Since it seemed inadequate by itself, one possibility would be to use it in a very limited way to increase the students' verbal repertoire. Students are interested and motivated for the first two or three weeks, so why not use the program to teach them basic vocabulary during that time? After that, discard the program and proceed with the usual classroom teaching. In addition to accepting the program's limitations and confining its use to the things it can accomplish by itself, one could also seek ways to "enrich" or supplement the program. The teacher realized that he could give lectures or assign further readings to strengthen the communication of principles and frames of reference, but he spoke of this possibility with little enthusiasm. Another way to supplement the program would be through careful selection of students – hoping, in effect, that the students themselves would supply what the program lacks. Thus, this teacher felt that the students with whom the program might work would be very enthusiastic, conscientious, bright students who also have superior mathematical ability. (This is also the teacher's description of the one student for whom he felt the program had been appropriate.)

Finally, this teacher wondered, as most teachers before him who haven't tried it, if the program might not be good for "remedial" students – simply as one more thing that could be tried with them.

### REQUIRED ALGEBRA COURSE

Two teachers used two leading published algebra programs with three classes. The students were freshmen boys, and the classes were chosen at random from the 1000 or so freshmen, after the top 90 or 100 had been drained off for "honors" courses. One teacher had one class, and the other teacher had two. One used teaching machines, and the other used the same programs in booklet form. This last teacher also had a similar class which he taught by the conventional methods.

Both teachers attempted to follow to the letter the publishers' instructions about the use of the programs. The procedure, as they understood it, should be: *a)* The students proceed at their own rate through the materials. *b)* Students, when stuck, will review the section of material immediately preceding the difficult spot; if that doesn't enable them to move again, they will ask the teacher for help. *c)* Teachers may use "enrichment" devices and class discussion. But it is strongly implied that the programs do all the teaching, and that "enrichment" is mostly for increasing motivation and interest. *d)* At various points in the program – corresponding to the completion of a unit of work – the students are to be tested. The tests are to be graded and discussed with or corrected by the student.

These procedures were followed exactly until the last month of the year's course. At this point one teacher abandoned programed instruction and returned to his usual classroom operation. The other teacher continued with programed instruction to the end.

Since the teachers were in close communication throughout the year and since they told us almost exactly the same things – both alone and together – we shall report their testimony as if it were from one person.

*The Materials* | There was a good deal of comment about the restrictive nature of programed materials. The programs were expensive – about $15 per booklet. The sheets and booklets could, in the opinion of the teachers, be easily torn and damaged. Moreover, it was uncertain whether the same booklets and sheets were to be saved and used again.

Programs, therefore, could not be taken out of the classroom, homework could not be assigned, and students were told to write answers in separate notebooks rather than on the printed program. Both teachers felt these restrictions were hampering. They found that the "no homework" restriction was, in addition, embarrassing: parents, some of whom had had rather negative reports from their offspring, asked for explanations of the lack of homework. The teachers were relieved that the parents turned out to be willing to go along with the "experiment."

Programed materials were passed out and collected each day – an expenditure of about 10-15 per cent of the total class time. Eventually, one of the teachers enlisted a few students to take care of this chore before and after class, thus saving the time of the class at the cost of "imposing" (the teacher's word) on a few students. The teacher in the class using the machines said that they were difficult to keep in working order, and that this was a fairly continual source of annoyance.

*Efforts at Enrichment* | Both teachers rejected creation of diversions simply to make the class more "interesting," but felt the necessity for holding classes on particularly difficult topics of the programs. Both found it virtually impossible to make a satisfactory presentation of such topics because the students would be at such a wide range of different places in the program. (Neither of them attempted subgrouping for the purpose of supplementary discussion.)

Both teachers were uncomfortable during the entire year because they felt they should be supplementing and enriching the work, but could not hit on a practical way to do it.

"A good bit of time was spent giving help to students who asked for it," and the instructors felt that these students were helped more effectively than would be possible under regular methods of teaching. On the other hand, there were some students (one gets the impression of a sizable percentage) who did not ask for help. They were "extremely reluctant to ask for help when they did not understand something." These students were characterized as shy, and fearing to be conspicuous.

The teachers suggested that probably a good many of these shy students would have received more help in regular classes, for the whole class "listens in" on explanations requested by one or the other student.

A student who misses class because of illness, or falls behind for some other reason, may be punished less in programed procedures since they allow students to go at their own pace; but we shall see that in these classes there were, in fact, fairly strong pressures on students to "keep up."

*Tests and Test Results* | One of the publishers provided tests, the other did not. The published tests consisted of three forms, each containing a 30-unit examination, and the forms were bound in one folder. The teacher finally had the tests reproduced, and rearranged the answer sheets so that scoring could be done more rapidly. With approximately one test a week from every student, scoring turned out to be quite a chore, and the instructor eventually arranged for "outside" students to do the scoring.

For the program that came without tests, one of the teachers undertook the task of writing the examinations. For the most part, he used frames from the actual program with little or no change beyond substituting different numbers in some of the problems.

The teachers understood that they were supposed to discuss each test individually with each student, but simple calculation showed that there was not enough time in class for this to be possible – especially since they were also supposed to be available to help students with the programs. The student scorers, therefore, were instructed to write in the correct answers and return the corrected tests to the students. Neither teacher felt that this procedure was educationally sound and their discomfort was aggravated by the fact that so many students missed so many of the test questions.

Both teachers were astounded at the test performance of their students. One found mistakes running as high as 50 per cent on some tests, the other estimated that good students averaged about 65 per cent accuracy whereas poor students ranged between 20 and 30 per cent accuracy.

On the basis of conversations with their students, both teachers concluded that students could go through the program, apparently successfully, and still retain little or nothing from it. Part of the reason, they suspected, is that these students "did not know what they were doing as they went through the items, nor why they were doing it." The teachers concluded that in spite of publishers' claims, the programs induced little or no "critical thinking."

At the end of the first semester, no student received a failing grade; "it would be unfair to fail anybody because the whole system was so new to them." At the end of the year, a few students were failed.

The business of assigning grades presented the teachers with a severe dilemma which they tried to resolve "by radar." Some students passed many tests with low scores; others passed fewer tests with high scores. Which student should receive the higher grade – especially when the different groups may not be trying equally hard? When we pointed out that we thought students were not supposed to be passed until they had achieved a mastery score on the test, the teachers replied that they did not enforce this rule for two reasons:

1) They questioned whether certain students would *ever* be able to achieve mastery-level scores; they doubted that the program could bring all the slow people up to the same point of the faster, more capable people; they considered the requirement unsound because it was unattainable.

2) The teachers questioned how good the tests were, anyway. They had very little confidence that it was necessary or important for the students to do well on all the tests. They reiterated that the students would undoubtedly do poorly on tests given in the conventional classes because the program leads the student from parts to wholes – which does not produce understanding of part-whole relationships.

It seems fair to wonder just how (if at all) the teachers' lack of confidence in the tests and in the pedagogical principles of the program may have given the students cues for much of their "amazing" behavior.

Students got bored with the program after about three weeks. The slow ones were bored because the program simply was "not interesting" (but see below) whereas the bright students were bored because it was so repetitious. Both types of student felt cheated: they were not getting "as much" as they would from the conventional class.

When asked what the teacher should do when boredom sets in, the reply was "put on the heat – keep moving." Repetition is indeed dull stuff, and the bright kids want "to skip whole bunches of frames," but this must not be allowed.

Nevertheless, some students apparently cheated on the tests (by receiving help from nearby pals) and others cheated on the program by skipping large segments of material, and then getting through the test with the help of answers supplied by buddies who took the test earlier.

A contributing factor to the distaste for the program that really competent students felt was what they reported as lack of precision or rigor in the use of terms, and in the reasoning presented in the programs.

*The Importance of Reading* | The instructors were "fascinated" by some statistics by the publishers which asserted that the average student does 150 to 200 frames per hour. Yet the classes here under consideration were averaging about 50 frames during a 40-minute period, a rate of 75 frames per hour. Both teachers felt that the higher rate must be based on the assumption that all the students are good readers, by which they meant that they were all "up to their own grade level." The teachers seemed to distinguish two levels or kinds of reading: 1) a passive noting of words; and 2) comprehension of the words and ideas. The poorer students seemed mostly at level one.

The notion emerged that the algebra program was, for most of the students, a reading assignment rather than a mathematical exposition.

The teacher believed that the oral communication of the usual classroom could get across a great deal more than the reading of the program for many students. One of the teachers, while not denying the symbolic nature of algebra, claims that it is essentially nonverbal, and that poor readers in his classes ordinarily are well able to learn algebra under the usual methods of teaching. This was certainly not the case vis-à-vis programed materials. It was pointed out, by way of finale, that comprehension of oral materials is usually ahead of comprehension of written verbal materials, often by as much as two or three years. If this be true, then the "algebra age" of a class taught entirely through reading would be the equivalent of students two years younger.

*The Teacher's Role* | One of the teachers talked at some length about his feelings during the period of programed instruction; the other teacher had little or nothing to say about this.

The teacher said, "I want to teach and instill enthusiasm in students; I want to shape their attitudes about math and indoctrinate the class favorably toward math." It appeared to us that this teacher prefers a dominant, interactive, close, emotionally permissive relationship to his students; and that "teaching" is something one does to the whole class. His image may be something like the captain on the bridge, steering the ship by wit and wisdom, and driving it by threats, persuasion, encouragement, and humor.

He talked freely about the discomforts in his role.

He was aware that the students were bored, and he didn't like himself for putting them in that position. His inclination was to call the class together and give them instruction, but he felt that this would be violating the rules of program self-sufficiency about which he was trying to get evidence. Then, too, all the students were at different places in the program, so what could he pick as the topic? This inability to take command of the classroom and make oral presentations gave him real discomfort.

While the students were working on programs and not asking for much help, the teacher claimed to feel "like a policeman."

He said he would wander restlessly about the room and fall with great relief on any student who held up his hand.

He asserted flatly that the students felt they got "much less" from the programed instruction than they would have obtained from classwork; he felt they saw him as sadistically depriving them of their due, and this conflicted strongly with the usual perception of his students that he had much to offer them and that the sky was the limit.

Finally, this teacher's initial high and eager expectations of the programs rapidly gave way to severe lack of confidence in them; the teacher himself felt badly cheated.

Both teachers were strongly of the opinion that students get a great deal more out of conventional math teaching and retain their learning a great deal better than they would through any imaginable use of programs.

*Who can Benefit?* | Neither of the two teachers felt that the programs were suitable for slow or remedial students.

They felt that certain programed units might be used for enrichment for accelerated students. Such units would cover the parts of the book the class usually does not get into. It was felt that the bit-by-bit presentation can plunge a motivated student rather rapidly into the topic, and that if the unit is short, enthusiasm might hold up.

We asked the teachers whether the programs might be useful to poor teachers – those who do not have the dedication and inspiration of the present company. Their answer was an unequivocal – No; it takes more skill, creativity and insight to teach *with* the program than *without* it, because the teacher has to know thoroughly everything in the program in order to deal with the wide range of individual difficulties he will be exposed to.

If one turns this idea around a little, one can see that what the teachers may be saying is that within the classroom structure created by the teacher, the emergence of individual difficulties can be controlled by the teacher, and when admitted, can be dealt with more on the teacher's terms.

The teachers suggested the following as the "best" use of programs: *a)* one or two days of lectures to overview the next unit of material; *b)* a class divided into subgroups by ability and rate, and each subgroup responsible for the learning of its members, and *c)* a teacher serving as consultant to subgroups, rather than to individuals. Such an arrangement would, incidentally, be an ideal one for team teaching.

*Student Evaluations* | During the last week of their algebra course, the 15 students in one of the classes wrote up their evaluations of their eight months' experiences with programed materials and their month's experience with "regular" teaching.

In general, the reactions of the students are unfavorable to programed instruction and favorable to classroom instruction. Of the 15 students, two claim they did not learn much from the program, and 11 claimed they learned a great deal from class instruction. For learning, 13 favored classroom teaching and the other two offered no general evaluation. One succinct statement probably describes more eloquently than most the students' almost unanimous consensus of opinion: "The teaching machines start off to be a big blast, but after a few weeks it's a drag. Questions get corny and the tests are way out."

Of course, these are the conclusions of one particular school, taught by a particular teacher, using a particular program in algebra.

### REGULAR GEOMETRY COURSE

The geometry teacher, like the others so far discussed, used the program for a year. He attempted to follow the publisher's stipulations and use the program as the major or sole source of instruction.

This teacher had been in close communication with the two teachers just discussed. We therefore did not attempt to interview him exhaustively, but merely asked him to express his opinions. Here are our notes on this short visit:

"Mr. X agreed that the present program, which he had used as a self-contained teaching method, was extremely boring and that any use he could think of for the class as a whole, involving other enrichment, supplementation or organizational arrangements, would not lead to results as satisfactory as his usual classroom teaching. Mr. X felt that even in its own terms the program was especially bad in not having sufficient exposition of proofs of theorems in geometry, and he led us to suspect that many other parts of the program also failed to meet his standards.

"Mr. X did, however, feel that for accelerated students who wanted to cover more ground or for the dull, slow student, programs might have some usefulness. He was unwilling to say that the whole idea of programing is unsound, and he did like the idea of feedback. But he certainly felt that programed materials would not be of any great use to him in teaching his regular classes."

### ELECTRIC SHOP — PROJECT METHOD

In contrast to the above mentioned classes, in which the teachers are continually frustrated by trying to combine individual work at different rates with activities participated in by the entire class, the teacher in the electric shop operates consistently. Students proceed at their own rate through *all* the activities, and there is never a time when the teacher tries to bring them all together for instruction.

The problem of "enriching" the program does not bother this teacher because the backbone of the course is the projects, and these are for the most part self-motivating. Short units of programed materials at the end of each project are used to "enrich" the projects, rather than vice versa; and the success or failure of the enrichment materials makes little difference to the student's progress in the course.

In further contrast, this teacher is well satisfied with the programed units, and intends to continue with them.

We talked with him and some of his students during a regular class period in the shop. Half the students were working, either alone or in informal subgroups, on projects such as wiring a circuit in a way that specified events would be contingent on pushing switches in the right pattern. The students were absorbed in these projects, and talked freely among themselves and also to students in adjacent projects. The teacher was quite relaxed; he offered friendly consultation when asked, and occasionally volunteered a comment; but for the most part he was allowing the students to work through the projects in their own way. There were two shelves of texts and reference books, and both the condition of the books and our own observation testified to their use by the students.

The other half of the class was seated in tablet armchairs in one section of the room. Some of these students appeared to be writing reports, others were in possession of teaching machines or program booklets. These students, having finished their last assignment, were between projects, so to speak. Possibly because of the distraction of our conversation with the teacher, the work on the programs was extremely lackadaisical. One student who had a teaching machine made no response to it during a timed ten-minute period. Other students made few responses, and carried on quiet conversations with each other whenever they felt the urge.

The teacher said that he thought the students' comprehension was increased by the programs, but he would prefer to wait for the year-end tests before making a definite statement. Regardless of the amount of learning, he felt that the programs were valuable to "fill the gap between the end of one project and the beginning of another." In the past, there was often a hiatus – possibly, we guessed, a disorderly one – at the junction between projects. The student is often not quite ready to tackle a new project immediately on completion of the preceding one. He needs a "breather." The programs offer this breathing period and yet at the same time maintain the forward movement of the course.

With regard to the programed materials, the teacher felt the machines were a waste of time, and that the restriction against going back and forth among the items was foolish. He felt that the best arrangement would be for the teacher to alter the programs from year to year, either clarifying difficult points or adding new material. To this end he suggested that the materials might be put on cards and kept in a file drawer. He had no expectations of altering the programs himself.

### THREE ELEMENTARY-SCHOOL SITUATIONS

The difficulties encountered by the math teachers when they tried to treat the programs as major and guiding sources of instruction led us to wonder whether other ways of using the programs might lead to quite different results. The electric shop showed one alternative, that of using programs to "fill in" between projects in a course which makes no effort to hold the class together. But most courses are not dominated by the project method, and we were interested to find out if programs can be adapted effectively within the framework of more usual classroom instruction. Can the class be held together for discussion purposes and from one unit to the next, and at the same time profit from programed instruction which allows each person to go at his own rate? What compromise can be made between these diametrically opposed conceptions?

With these things in mind, we visited an elementary school and talked to the principal and three teachers who are using programs for the second year. General discussion brought out some clear arguments on the use of programed materials, and interviews with each teacher revealed some of the differences in patterns possible within the general areas of agreement.

*Areas of Agreement* | The teacher is the guiding director in the classroom. It is up to him to use such skills as he has to adapt the program to his ends; the teacher dominates, not the program.

The relationship between teacher and pupil is all-important, and it is a real advantage to have the same students in several subjects during the day. Under these conditions, the program may dominate some aspect, such as a spelling drill, but the teacher has other times for interaction and for getting to know the student well enough to help him. Work on the program is only one of a large number of activities in which the teacher and students participate each day.

It is quite clear that his teacher-"whole child" relationship plus the formation of the classroom group through a wide range of shared work-oriented experiences exerts strong forces to cause the child to take the program seriously. It is easy to ask for and get help in a cohesive class from a teacher who knows you well, even though the teachers agreed they had to keep a weather eye open for some students who found it hard to ask for help even under these conditions. In giving help, the teacher and child would turn back the pages of the program together, hunting for the cues the child needed.

In the climate of cooperation and understanding described by these teachers, cheating and skipping seldom happened, and when such incidents occurred, they were interpreted as indicating a lapse in motivation. The teachers had a number of ways to keep up motivation. They exploited the novelty and game aspects. They gradually broke down the children's initial notion that the program was a long test and that wrong answers would therefore be penalized. They gave help freely, and made it easy to ask for it so that children did not have to wallow in frustration for long periods. And finally, they tended to make the work on programs part of the class discussion with the teacher, rather than an end in itself. There was thus not only feedback on each item but also from subsequent discussion, i.e., feedback on the meaning the sessions with the programs.

The teachers recognized that the general climate of the school and community exerts strong pressures toward "achievement."

A final generalization from this group of teachers is that the machines have considerable drawbacks compared to using the same program in booklet form with a cardboard mask or stencil.

*Multiplication—Fourth Grade* | Programed booklets on multiplication were used between the tenth and 20th week of the year. Each period was 40 minutes long. The students worked on the program three days a week, and the teacher led discussions on problem-solving plus drill over the program on the other two days. The class was kept together with definite assignments of the number of frames to be completed each day, and the early finishers were given other things to do (e.g., read and report on an article). The teacher did not send the early finishers to the textbook for further practice because the section on multiplication was organized too differently from the program.

The teacher felt that the students learned about as much or slightly more, but that the chief benefit of the programs was that students could work on their own at different rates (as compared, presumably, to working out problems together as a class).

*Spelling — Sixth Grade* | For one semester, a program was used to teach spelling. The teacher thought very well of the program, and was grateful for its organization of rules, word lists and methods of attack on spelling problems. She felt that the programers had thought through the subject in the way all teachers should do but seldom have the time to do.

She claimed that the slower pupils needed a great deal of help, but that they were much intrigued by machine drilling. The program was not even close to being "error-free."

It was difficult to compare the programed class with a regular class because they used different spelling lists. The teacher thinks the slow students probably did better through the programed experience.

*Algebra—Eighth Grade* | The class was carefully selected and was composed of high-achievers. The program was used throughout the year, although several students finished several weeks early. (These were then given textbook problems to work on.)

At the beginning of the year, the teacher used the program five days a week; after a couple of weeks, she reduced this to four, and soon thereafter to three days per week. During the two days thus provided, the teacher gave her own tests, discussed them, gave additional explanations of inadequate parts of the program (e.g., literal numbers), and covered some parts on which the program dallied too long. She found that the slow learners needed a great deal of help.

For the next year, with a regular rather than a selected class, the teacher said that she would start the class together at the beginning of each unit. Students who finish a unit early will have textbook problems to work on. But the class would be paced together through the course. With a class of very bright students, the teacher thinks she would free the students to go at their own speed.

## Concluding Impressions

The central object of this investigation is the satisfaction or dissatisfaction reported by teachers and students who used programed materials. To the administrator or psychologist who believes that education can only be improved voluntarily through commitments and involvements of those on the firing line, satisfaction is an important predictor of available energy and probably of potential for creative action. Be that as it may, the organizing principle by means of which our testimony seems to be self-consistent and interpretable is that satisfaction with programed materials (as with sound-films, workbooks, and other aids) depends only partly on characteristics of the material, and that "other factors" may be far more important determiners of satisfactoriness.

The first operation of satisfaction-dissatisfaction is anticipatory: it manifests itself in the decision to use the materials or not. The reasons for nonacceptance, cited more or less explicitly by the respondents in our survey, are theoretical and practical. By inspection of the materials, a teacher may decide that what the materials teach is unimportant or irrelevant to his courses. The teacher may decide that the objectives are significant but incomplete: that the material could not possibly do the whole job by itself. Again, the teacher may decide that the objectives are adequate but the teaching method is not. If the objectives are inadequate, the teacher would logically "enrich" the program by bringing in additional materials; if the method is inadequate he would "reinforce" the program by discussion, practice, and application of the content in situations set up by the teacher.

We found instances of each of these kinds of decisions. Taking the decisions in order, we note first that the art teachers in one school simply could not find a program that was relevant to their objectives and subject matter. In addition, two schools report that the idea of programing is interesting, but they intend to write their own. The best example of "enrichment" is the electric shop, in which the teacher is highly satisfied with letting the program do part of his teaching, although this part amounts to only about a third or a quarter of the total course. Furthermore, what really differentiates the schools that intend to go on using programed materials from those that plan to give them up, is this "enrichment" usage: those teachers who used the programs to enrich their courses tended to be far more satisfied than those who used the programs as an entire course.

The clearest instances of "reinforcement" of the program come from the elementary-school teachers we interviewed. All of them let the program do the initial presentation, but they then led discussions and gave further practice with the program's content. These teachers also were among the "satisfied" ones.

A rather odd decision, dictated by the desire to give the materials a "fair" tryout, was that though the materials were really quite inadequate – both in respect to objectives and methods – the teachers should go ahead and use them *without* enrichment or reinforcement. Our four highly dissatisfied math teachers were in this predicament – or at least were in this predicament within a month after the course began – and it seems reasonable to suppose that this sense of being trapped resulted in further deterioration of the learning situation.

In view of the debate swirling around the claims of programed materials enthusiasts, it is appropriate to contemplate how this apparent need for enrichment and/or reinforcement beyond the programed materials themselves could be met. There are two views about how this additional activity might be provided.

One is that individuals and subgroups would proceed at different rates through the year's course, and that additional assistance would be given to each individual or homogeneously placed subgroup at the time and in the way required by his or their needs. We will call this "individualization."

The other view is that enrichment and/or reinforcement would be administered to the class as a whole, and that all the students would participate in the same activity. We will call this "teaching the class." If the "individualization" scheme can be made to work, then the claim of the enthusiasts – that through programing students can proceed at their own rate, with some doing two years' work while others do a year or less – can be realized. If, on the other hand, the "teaching the class" approach is adhered to, then the class must be kept together – at least at the beginning or end of each subunit (if the program has subunits), and the claim of individual differences in the "amount covered" simply cannot be made. In the "teaching the class" approach, it is true that individuals work at different rates through the same subunits of the program, but viewing the course as a whole, all this really means is that the individuals *distribute their time differently* among programed materials, "make work" individual materials (gap closers), and class enrichment or practice activities.

Our four math teachers attempted the "individualization" approach, but without enrichment or reinforcement activities. They did attempt to "help" individuals, but this help was presumably with initial understanding of presented material rather than with maintenance of habits or principles already learned. Their experience tends to discredit the extreme claim that the program can do it all, with only a small assist from the teacher. Two of the teachers, in thinking of how to "make the programs work," came up with the idea of homogeneous subgroups, each of which would be enriched or reinforced as needed. But they did not go ahead and try it. Thus we do not consider that the "individualization" approach really was given a fair trial, although we do consider that this publisher's procedures, presumably representing the "individualization" approach, were given a fair trial and found unsatisfactory.

Our electric-shop teacher did approach "individualization" but the use of the programed materials primarily as busy-work between projects does not dispose us to generalize from his experience.

To realize the alleged potential of programed learning will mean to make the "individualization" approach work. At first glance this seems like an easy thing to do — probably easier than "teaching the class"— but when we dig deeper into the experiences of the teachers who tried it (or an approximation of it) we discover that the matter is by no means simple and that the required conditions may, for most students and teachers, be extremely difficult if not impossible to achieve. Here, then, are some problems that are highlighted by the experience of our teachers:

First, *the more the program itself carries the full responsibility for teaching, the more appropriate it has to be for each student's needs and ways of working.* Thus, if the program guides 90 per cent of the activity of the student, whatever accommodations can be supplied by the teacher must be squeezed into the remaining 10 per cent of activities. On the other hand, if the program is merely an adjunct, using 30 per cent of the student's time, then the other 70 per cent is available for developing readiness, anticipating difficulties, deciding on reasonable expectations, and doing other things to maximize the benefit of the program. It appears that the greater the guidance by programs, the more will different programs, suited to different "types" of students, be needed. The required number, on the assumption that the "fit" must be good between program and student, would be extremely large. To arrive at a bare minimum figure, multiply five different reading levels by five (at least) levels of present understanding of the "subject," times four (at least) approaches to meaning (e.g., through verbal manipulation, problem solving, inquiry, and "application to life"), times three (at least) preferred ways of working (e.g., alone, in friendship group, in project group). Assuming independence among these dimensions, this will result in 300 different programs — to fit *just a few* significant aspects of the learner.

Second, *a way will have to be found to increase the range and amount of reward to the individual when he is working alone with the programs.* The general finding of boredom under these conditions had better be taken seriously. Persons under sufficient pressure may learn things when bored, but they are not learning these things "for their own sake," and most of the energy is going into dealing with the pain of boredom. Two striking reactions turned up in our data: first, the elaborate and ingenious ways of short-cutting the program (called "cheating" by the teachers); and second, the oft-noted phenomenon of going through the program, apparently satisfactorily, and then being unable to pass tests or answer questions about what it is that one has been reading or answering. The alleged reward from immediate feedback, telling the student that he has made the right response, is simply inadequate.

The various sorts of deprivations felt by those using unenriched programs call attention to the tremendous range of classroom rewards that we more or less take for granted: showing what you know by putting it on the board; being able to answer correctly when a hard-boiled teacher calls on you; being bawled out by a teacher who uses this technique to show that you matter to him; enjoying getting to know how a teacher operates, not only with respect to solving "subject matter" problems but in a wide range of human classroom situations; and finally, being able to assess oneself against other kids, not merely in algebra but in real-life dimensions of classroom living.

All these, and other rewards connected to "developmental tasks," may act as powerful forces for keeping the student going in classrooms. Their counterparts in "individualized" programed learning are either nonexistent or weak. What reward possibilities might be tapped? The social and interpersonal seem to be ruled out for the most part. There remains, then, the possibility of the personal – the excitement of discovery; the challenge to imagination, the involvements of speculation, the invitation to dispute, and the encouragement of personal opinion. But programs seen as repetitious, imprecise, and boring could hardly be said to offer much promise along these lines.

In fairness we have to point out that the social and interpersonal rewards mentioned above as the traditional stimulus to participation in activities (if not in learning) in the classroom do indeed represent "extrinsic" motivation, quite apart from disciplinary or insightful meaning of the "content" principles. Achievement in pursuit of these rewards is second best when compared to achievement in the pursuit of meaning; and many persons, including the present authors, are much concerned about the development of behavioral science-based theories of instruction that will turn education into an experience of inquiry into meanings. But eliminating these second best rewards does not, as our testimony shows, automatically place the more appropriate "intrinsic" reward possibilities in the picture. It merely eliminates one major reason for working.

Third, *a variety of factors over and above "program fit" and motivation enter the picture and will have to be dealt with in the one-to-one individualized relationship between student and teacher.* We are here referring to a potpourri of "conditions," "climate," and "concomitant objectives." The existence of these factors stems from the fact that the child is always a "whole" child with integrity built around his "way of life." He is not merely a reader of programs nor merely a "member" of a classroom group. He is, in short, a human being. The sort of thing we have in mind here was well recognized by our elementary teachers when they pointed out that an important reason for their success with programed learning was that they had the same children in other subjects and activities during most of the day. In their terms, they "knew" the children, and this knowledge, along with relationships developed and reinforced through all their shared activities, provided a secure basis of support, trust, and disposition to seek meaning during the time students were working on programs. At the risk of sounding fanciful, we are tempted to suggest that the self-contained elementary classrooms of these teachers had become significant *communities* in which pupils lived and participated. Working the programs was just one of the many tasks undertaken in this community, but the attitude adopted toward this task was of a piece with the generally cooperative and optimistic spirit characteristic of the classroom life as a whole.

However uncertain we may be as to what specifics to subsume under the general heading of "spirit," we at least know something about how this spirit develops: through sharing of personally meaningful perceptions of a wide range of activities in which all are involved. A prominent component in this development is the taking of risks together – the teacher through open-mindedness, and the students through reaching over their heads. It is hard to see how programed materials can instigate an adequate range of activities (and ways to know each other). But they apparently can provide an adequate opportunity for risk-taking by the teacher. In fact, two of our math teachers felt that for the inexperienced teacher programs would be disastrous because "the teacher has to know thoroughly everything in the program in order to deal with the wide range of individual difficulties he will be exposed to."

We feel that with a great deal more training in "helping" students to contend with programs, teachers could develop some of the valuable concomitants of "creative listening" in the classroom; but we also feel that the range of situations provided through the programs may well be too narrow to make the results very impressive.

Fourth, *there is the problem of keeping the teacher (no less than the student) alert, active, and challenged.* Three of the math teachers were dissatisfied because the role they were assuming vis-à-vis the programed activity was not congruent with their own needs. And even the teachers who expressed satisfaction in no way indicated that their personal satisfaction came from supervising work on programs; rather, it came from the "enrichment" and "reinforcement" activities that they set up and ran for themselves. It is difficult to see how supervising programs could have anything like the reward possibilities for the teacher that he normally gets in the classroom, unless the teacher had written the program himself or, at least, had become actively "involved" with it in some other way.

In conclusion, then, we believe that the testimony of our teachers supports the following assertions:

*a)* Programed materials (including appropriate tests) used by themselves, are not likely to satisfy either teachers or students.

*b)* Programed materials, used within a consistently "individualized" method of teaching, would enable students to move at their own rate as far as they are able; but there are formidable problems that will have to be solved before an appropriate teaching method for this objective can be described with any assurance.

*c)* Programed materials, enriched and reinforced by many other activities within the class – in other words, employed simply as adjunctive aids like workbooks or films – can be used successfully by teachers but only at the cost of giving up the concept of "each student moving as far and fast on his own as he is able."

*d)* From the testimony of teachers, little emerges about what is, in our own opinion, the most significant challenge of programed instruction: how to turn education into an experience of meaningful inquiry by the students. Present programs do not do it. And until programing principles can be established to tap the level of "personal meaning," we doubt that their utility can be greater than that of any new-type workbook used to help "teach the class."

# Programed Instruction in a "Continuous Progress" School —Provo, Utah

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# Programed Instruction in a "Continuous Progress" School —Provo, Utah

## The Setting

Much has been written about the theoretical advantages and potentialities of programed instruction. But how does it really work out in the schools? This is a report from those who have actually been working with it on a day-to-day basis.

My special bias has been a belief that commercially available programed materials are not sufficiently developed to give programing a fair public trial. Recently, however, I have looked at a school that had decided to use programed instruction intensively as part of a "continuous progress" curriculum. What follows is the result of many recorded interviews, transcribed from tape and slightly edited by me to incorporate my questions.

The place, in this instance, is the Brigham Young University Laboratory School in Provo, Utah. This school is using various forms of programed materials in grades K through 12.[15] College students at BYU use some of the same facilities and materials for college-level work. The school has used programed materials for two years in several subjects with considerable success (and many problems) and their experience should be of interest to anyone who would try to use this means for improving education.

The Brigham Young University Laboratory School is housed in a collection of older brick school buildings in downtown Provo, several minutes removed from the impressive new university campus. The buildings occupy a full and extra large square city block. There are big trees lining the streets and shading the well-stamped playground area that surrounds the buildings. There is a kind of familiar and nostalgic atmosphere about the place for those of us born before the roaring twenties and reared in small American cities.

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[15] In kindergarten, locally prepared materials; grades 1–3, Science Research Associates *Reading Laboratory*, plus locally prepared spelling materials; 4–6, Harcourt, Brace and World *Mathematics Enrichment–Sets, Numeration, Geometry*, Encyclopaedia Britannica *Improving Your Spelling*, and Webster Publishing Service *Exploring Arithmetic*; 7, Britannica *Whole Numbers and Numerals, Seventh Grade Arithmetic*; 8, McGraw-Hill *Using Mathematics*, Britannica *Basic Mathematics*; secondary level, Harcourt, Brace and World *English 2600, English 3200*; 9, Science Research Associates *Modern Mathematics, Course I*, Britannica *Algebra I*; 10–11, Britannica *Algebra II, Plane Geometry*; 12, Britannica *Introduction to Sets, Inequalities, and Functions*, Addison-Wesley *Modern College Algebra*, Prentice-Hall *Calculus with Analytic Geometry*.

There is an attempt to keep the school as heterogeneous as possible but the school is, in fact, private. Students apply for admission, are selected, and pay a tuition. Despite the selectivity, the tested IQ range is from 68 to 160. Approximately 25 per cent of the students are children of Brigham Young University faculty members. The school has one classroom of children at each of the elementary grades and the equivalent of two classrooms in grades 7 through 12. The number of students involved in using programed materials in specific subjects declines rapidly in the senior high school, as can be seen in the following table which shows the number of pupils actually enrolled in programed mathematics.

| Grade Level | Total Number of Students in Each Grade Level | Number of Students Enrolled in Mathematics |
|---|---|---|
| Seventh grade | 66 | 66 |
| Eighth grade | 66 | 66 |
| Ninth grade | 67 | 67 |
| Tenth grade | 67 | 54 |
| Eleventh grade | 69 | 33 |
| Twelfth grade | 65 | 11 |

The 400 students in grades 7 through 12 represent just a small fraction of the students in the area. Provo High School, for instance, has an enrollment of about 1800 students. The private school is maintained as a laboratory school by the university and many student teachers observe and learn in the facility.

The director of the Laboratory School at Brigham Young University is Dr. Edwin A. Read. Dr. Read is intense, enthusiastic, alert. He looks directly at you. His voice is soft but assured. I asked him to give me his general impression of programed materials, and he answered without hesitation, as if he had been asked the same question many times.

"If you want to use programed instructional materials you must realize that they are a little out of place in the conventional school. Programed materials are designed for individual use. They are designed to make it possible for a person to study at his own rate. When you put them in a conventional classroom it just frustrates the teacher who tries to keep everyone going at a constant rate. Actually, textbooks don't allow students to go at their own rate. Most textbooks are really designed for teacher use. The teacher instructs from them. We find very few textbooks are very well written for student use. They are really prepared for the teacher as a source from which to give assignments. Then, of course, individual use requires some feedback or some reinforcement from the teacher. A student uses a textbook for a period of time, say overnight, to do some work at home. He expects his reinforcement to come in one lump sum when the teacher talks about it the next day. But when a student is learning from programed materials – working on his own – the programed materials give him immediate feedback. The best thing we could do with texts was to have an answer book. The students got some feedback that way, but, as you know, it's feedback that comes after quite a lot of work."

As Dr. Read continued to speak, I quickly concluded that the procedures being employed at the laboratory school are so different from those used in conventional schools that most educators would be appalled, or at least confused, by them. Teachers who have expressed concern about what programed instruction would do to existing school systems will be pleased to learn that their concern is well founded – at least in the opinions of some teachers who are now relatively experienced in the use of some commercially available programed materials.

## The Curricular Context

A new organizational plan for instruction was the primary reason for adopting programed materials in the school. I asked Dr. Read to describe the new procedures.

"We call it the Continuous Progress Plan. The idea got started in the 1959–60 school year. Working closely with Dean Woodruff at Brigham Young University, a committee of the faculty began studying ways and means of improving a school system which we felt did not properly take care of individual differences. We had studied the Trump Plan and had felt that while it was a great advance in education, it was essentially an expediency in a time of teacher shortage. It did not answer the question of how to take care of individual differences. So we said, well, let's pretend that there isn't a school system and we are on the island of Utopia. We can develop our own plan. What kind of a school system would we have if we would take account of all we know of how students learn, all we know about their needs and abilities. With this, and with Dean Woodruff's approach to curriculum building, we developed the Continuous Progress Plan. It is a plan which allows students to progress through the curriculum at their own rate, which trains them in how to study from the time they are very young, which teaches them basic study skills while they are still in the elementary school, and to take responsibility for their own progress. It provides for their social development in that it gives some time with other students in groups. Social activity is in large groups but instruction is in small groups. It provides students with good study habits by giving them the skills of study . . .

"In the school year 1960–61, when we first started to try the plan, we had no programs. We did it strictly with texts. It was difficult, and then in the year 1961–62 we were able to get TEMAC – our first programed materials. And we were able to introduce, during part of that year, *English 2600*. Then this last year (1962–63) we have added new materials. Now you ask what was the attitude of the teachers. It was very favorable. We had no problems whatsoever with the teachers because they needed programed materials so badly. The Continuous Progress Plan absolutely demanded it. So, after they had spent a year in the plan without appropriate materials essential to individual study they simply welcomed them, and went right into using them. Not *just* programed materials, mind you, but single-concept films and tapes, what we call study kits, manipulative materials, and some straight study guides – some of which we have developed. These guides direct the student in his study and lead him by a questioning technique to arrive at certain generalizations and concepts in much the same way that a teacher would if he sat down with a group of students. The concepts and generalizations which the students actually develop are checked with the teacher when they meet in their small clusters for instruction. We think that programed materials will do a lot. But there are some subjects that are not as well adapted, or at least haven't proven themselves to be as well adapted to programing as the pure sciences.

"We may be able to program social studies and English literature well, but right now we don't have these materials. Even if programed material was available we think it would have to be supplemented with other media because of the fact that the social sciences are not nearly as scientific – as pure – as the physical sciences. There will have to be other materials because students will have to make their own value judgments in many of the social studies. If this area is subject to too much programing, it could become indoctrination. While I do think many of the historical aspects of the social sciences can safely and effectively be programed and probably should be and will be, there will be many concepts left to be taught by methods which lead the student to arrive at conclusions on the basis of his value system.

"It might be possible to program materials in such a way that the student is not led to some prescribed behavior but I haven't seen any such programs. In the study of great writers, for example, we don't want to indoctrinate students to any particular insight that somebody thinks the writer has in mind. One author may think that Shelley was trying to give us certain insights into human life but others may think quite differently, and it is common for different authorities in the field of English literature to give very different interpretations of what the authors have been saying. So, this will have to be open-ended, too. Unless we can program that way, we will have to use some other learning resource.

"It is true that programed material is about all the material we have been using in mathematics. Our teachers believe, on the whole, that programed material is good, but they believe it should be supplemented. You'll find, I think, in interviewing students – particularly younger ones who speak out quite honestly and frankly – it can be pretty boring to be doing programed materials day after day. However, this monotony is broken by working with clusters of students and with the teacher. Receiving instruction by programing is effective, but we believe that it must be supplemented. We think that programing could furnish a kind of backbone of basic information but that the teacher's role is still a very major one."

It seemed to me that two tentative guidelines could be developed from Dr. Read's statements. First, *it is essential to develop a need for programed materials before you introduce them.* Second, *programed materials seem to be more suitable for certain kinds of educational goals than others; therefore, they should be used to supplement rather than to supplant present teaching methods and materials.*

A teacher said:

"In addition to their daily work, students take unit tests in their regular arithmetic book. When they complete a unit of work, they take a test on the material covered in the book. I personally check this test. Then I give them a mimeographed test that I have made up, so that I can find out again whether the student needs any special help on different areas in the unit.

"I would say that students don't look ahead to the answers in the programed materials before they write their answers. I've never found a problem, even to the smallest degree, in this respect. Students have learned to accept their status and work individually. It's kind of an understanding that there is no need to cheat. There is no punishment if they answer incorrectly. They know they're going to get help if they miss anything and so it's not a matter of cheating, but rather of competing against themselves. Some students get farther ahead and this does give them satisfaction. The only trouble that we've had in this program, really, is the fact that some students want to do too much homework. We have really had to curtail this a little and request that certain students don't take their book home. Parents were complaining, at one parent conference, that all the students wanted to do at home was to work on the program.

"Programed materials are the most valuable thing I've found to keep up interest, and they also give the teacher time to help with other problems."

## The Uses of Programed Materials

After my brief orientation, I was eager to see students working with programed materials and to find out more about how the Continuous Progress Plan functioned. I noticed that different procedures were used at the elementary, secondary, and higher levels.

### ELEMENTARY LEVEL

At the elementary level the classrooms were self-contained. Each teacher used programed materials in a slightly different way, and each had a range of materials. In the sixth-grade classroom there were programed materials which initially had been prepared for the fifth, sixth, and seventh grades. But materials were not provided in classroom quantities. In one sixth-grade class of 30 students, for example, there were only four seventh-grade TEMAC *Basic Mathematics* programs.

Mr. James Beard was the sixth-grade teacher in the laboratory school. He explained that his class was a typical heterogeneous group that had about eight really capable math students, but that all of his students readily had found the materials which were most appropriate for them. While all started on sixth-grade materials, Mr. Beard explained that some students experienced real difficulty with them. When he had some of his students on fifth-grade materials they moved along at a better speed and enjoyed them more. Each student had a notebook and kept a record of his place in the programed materials.

"The system requires each student to check his own work and the teacher gives periodic tests. Each day every student writes his answers on an answer-sheet which he constructs. The program, of course, provides him a convenient means to check whether his answer was correct or not. Students then turn in every answer-sheet to me after they have checked it and I check their work before filing it so that I can see daily if the student has a lot of problems. If he's missed a lot—well, take this boy: right now, I need to get with him and find out what his problem is. Maybe he doesn't know how to invert—maybe he can't find the common denominator method in division of fractions. I have a day-by-day check on the students because they do no more than two pages without checking it and turning it in."

The fifth-grade teacher was Mrs. Glenna Hanson, who had taken over in the middle of the year. She had taught previously in California and was in her ninth year of teaching.

"At first, I began to wonder how I was ever going to manage and it took a couple of weeks to get on to the pattern, because I was taking over in the middle of the year. It was difficult for me, but not for the children; they knew what they were doing. I felt at first that maybe I wouldn't know exactly where every child was, but it only took a couple of weeks for me to get on to the system. On the tests that I make up myself, I'm interested in seeing which students need help in certain areas.

If they have below 80 in any given test, we review that material and they don't go on in their books until I have helped them with their difficulty. I want to make sure that they are not covering the material too fast. And then they also understand that when they come to something new – for instance, when they were beginning fractions and there were new concepts to be learned – they were not to go any further until we have a discussion group."

Mr. Harward was the fourth-grade teacher. Some of his pupils were working in fourth-grade arithmetic books, others in both third-grade and fifth-grade books.

"The fourth graders have had a difficult time in these math books, proceeding on their own without a lot of teacher guidance and help. Because of the way the material is presented, they are quite independent, I think. But when I take the same materials out and prepare the same concepts in another way, they seem to come up with suggestions and discover for themselves some of the concepts we're trying to teach. I have prepared, for example, in fractions, sets of papers where the student can proceed on his own and arrive gradually at some concepts by himself. I have also done this with reading. The use of these materials depends so much on the students and their ability. Some students, when they come into the fourth grade, just don't have basic math skills, for example. The fourth grade is a kind of a transitional year. It's only been the last part of the year now that we've really been able to move, with a number of students progressing and taking responsibility for their own progress, for their own achievement and for setting their own goals. But some of them are still not ready. The math books we have are just not written for a student to proceed on his own. They are arranged for a teacher to take a group and to introduce, demonstrate, and illustrate before the student can go on his own. I didn't mean to indicate that with the programed material they couldn't go ahead on their own. When they really need help is when you give them a regular textbook and leave them on their own."

As I talked with teachers in the primary grades, I discovered increasingly greater latitude in the use of various kinds of self-instructional materials. One conversation with a fifth grader was informative in another way. The best way to describe him is to say that he was "all boy." Our discussion was as follows:

Q: What's this book about?

A: Well, it has three sections. It has sets, then it has geometry and then numeration.

Q: What is numeration?

A: Well – I'm just starting it.

Q: Well, what are sets?

A: Well, they are a set of anything.

Q: What was the other part?

A: Geometry.

Q: Did you get quite a bit out of that?

A: Well, I just got done with it and I ain't done this for a long time.

Q: How about the tests? Were the tests hard?

A: They don't have any tests. They just have these pages.

Q: Did your teacher give you a test?

A: Well, not me. She did at the first of the year to see if we knew what we were doing.

Q: Did you know?

A: Yeah, but it took quite a while to catch on.

Q: How much time do you spend on this every day?

A: About ten minutes.

Q: That's about all the time you get to work on it? How do you like it?

A: Fine.

Q: Do you like it better than regular teaching or not?

A: Well, I kinda like this better.

Q: Would you like to spend more than ten minutes on it?

A: Yeah.

Q: How much time would you like to spend on it?

A: Half hour.

Q: Do you get pretty good grades in school?

A: They don't give you report cards. They just give you a card that says: "Robert has passed the fifth grade and is going into the sixth grade, or something."

Q: Is school easy?

A: No.

Q: Do you spend any time at home working?

A: Yes.

Q: How much time do you spend at home working at night?

A: Well, that depends on what you have to do.

Q: Do you work every night?

A: Not every night.

Q: How do you think the other kids like these kinds of books?

A: Same as me. They all like it.

Q: Is it easy?

A: No, it isn't easy. You've got to read it.

Q: Do you think you've learned more or less than with the ordinary kind of teaching?

A: I think you learn more.

Q: How come?

A: Well, you just have to.

Q: You have to make up your own answer pages, don't you?

A: It's neater if you do it this way. Some guys just number them down like that.

Q: I see. On page 154, there are six blanks so you put down 154 and then you put down 1, 2, 3, 4, 5, and 6. Now when you take a program, you write your answers in there.

A: Yes.

Q: Then when you finish writing all of these pages, what do you do?

A: Then you check after each problem.

Q: So you know if you're right or not, and then what?

A: Then if you're wrong, you have to make the corrections and see what your mistake was.

Q: But do you make it on here, or do you leave the wrong answer down here?

A: Well, you leave the wrong answer on, but just mark it and put the right answer on and look, and see what your mistake is.

Q: I see. Then when you finish the whole thing, what do you do with it?

A: Hand it in.

Q: Then the teacher checks it over?

A: Yes.

Q: Can you do as many of these as you like?

A: Well, after you finish your regular work, and your regular work is through.

Q: When you need help on anything, what do you do?

A: I go to a teacher's desk and wait in line.

Q: Is there usually a line?

A: Oh, a few people.

Q: Do you all work on this at the same time, or do you work on this whenever you feel like it?

A: After you get two pages done in your regular book.

Q: Do you take your book home with you very often?

A: Well, she doesn't want us to do too much at home because if we foul up at home, then we don't know what we're doing.

Q: Are all the kids at a different place in the book?

A: No.

Q: What do you mean? Are you ahead of them, or behind?

A: Oh well, some guys are ahead of me and some behind.

Q: Do you like the idea of everybody being at a different place?

A: Yes.

Q: Why is that?

A: Well, it gives you somebody to work up to, if they are ahead of you.

### SECONDARY LEVEL

The most extensive use of programed materials was at the secondary level (grades 7-12). The programed learning facility and its use was most interesting. On the second floor of the high school was a well-lighted L-shaped room with a floor space about the size of three ordinary classrooms. In straight rows were more than a hundred individual student study carrels. Each carrel was a three-sided, fairly private work space with five-foot sides extending back of the chair area. There was adequate desk space and a small signal light on each desk. Adjacent to the large room were three small rooms; two equipped with chalkboards were used as small classrooms, the third was a testing room which contained only chairs with single attached desk arms, and filing cabinets with appropriately labeled drawers for tests.

The class schedule was not significantly different from the typical school. Classes rotated approximately each hour and different numbers of students used the room each hour. The pattern was essentially as follows: each student carried with him the program he was currently using. When the bell rang he went to his assigned carrel and was free to study in his own way. If he had difficulty with the previous day's study, or questions about it, he had turned in a slip of paper at the end of the preceding day with the question or the area of difficulty noted. If he had completed a unit and was ready for the unit test he could indicate this on his slip. The instructor, having consolidated related questions from the previous day, could easily assemble a small group of students with a comparable learning problem. At the instructor's desk was a master panel used to turn on the signal light in any carrel. When a student's light on his desk lit up, he would move from his carrel to the instructor's desk where he was told to go to one of the small classrooms. There another instructor, most often a very experienced teacher, would explain, demonstrate, or discuss the troublesome problem with students who had previously indicated that they wanted help on it. This method appeared to work very well. Students ready for testing were similarly summoned from their carrels when space was available. A clerk was assigned to the testing area, distributing and scoring various tests, depending upon the individual student's progress in a given program. Obviously, the instructor tasks in the large carrel area and in the testing room were largely clerical. They would be ideal assignments for teachers' aids or clerical personnel.

I asked Dr. Read if the students were permitted to take the materials home. What other methods were used to provide supplementary instruction? What problems had been encountered? Had there been attempts to group students homogeneously? Dr. Read's answers were as follows:

"We believe that programed material ought to provide children with a better opportunity to do homework, so our materials can go home. Programed materials in the high school are rented to the students. We can do this economically by buying a number of sets and then renting them to students because each student does not have to have a complete set of materials at one time. Since they will be at different points in the curriculum at different times, several students can use one set of materials. You see this is not a public school; we can rent materials because students pay their own tuition. Normally, they have to buy their own books but we rent them the programed material. They don't mark up the programed materials since they use separate sheets for responses. We think that we can use programs for three or four years this way. When the materials are taken home we get reports from the students each day as to how much homework they are doing. Some students will do a hundred frames a night while others won't do any or just a very few.

"With reference to other materials of instruction, I can say that we have developed some tapes and we have the latest dialogue equipment. Students in one section of the carrel area can dial a tape and can get instructions from a teacher. We also have some visual plates to accompany the tapes. We are just getting started with such materials this year. Next year we will have short descriptive tapes (15-20 minutes) with visuals and other appropriate materials. For concepts that we don't think the programed materials are getting across very well (or at least not to slower learners) such materials will be used to supplement the programed materials that we have. Also, for concepts which are difficult for all students we will have supplementary materials to afford a break from programed materials and at the same time provide extra help. A student will probably see the teacher on film, in both math and English. We will have study guides, also. The study guides are very important, too, because, while we use programed materials and films, study guides will say essentially, 'after you finish frame such and such (for example, 5000), turn your study guide and follow through pages one through seven.' In that study guide the student might be referred to a good text which will give him the experience of solving some problems or explain in another way a certain concept in mathematics. This will reinforce the explanation given in the programed materials. He will have supplementary explanations on tape and supplementary information in study guides and some of the better reference books to go to for additional help. We have had the complaint from teachers that their students get so accustomed to programed material that they can't handle too well a problem that might come through some other source. Therefore, we intend to refer them through a study guide to a conventional-type textbook where a good explanation or another type problem is given.

"The thing I was trying to say about students who got accustomed to programed materials was not that they probably weren't learning as well but that we find they haven't been transferring the learning from the kind of problem they are required to do in programed material to the kind of problems they are likely to get out in life or in another text. I don't think we could say, yet, whether it is characteristic of programed material in general or just the particular materials we are using. We have students tell us that though they can do the programed material in grammar, when they take other kinds of tests from our teachers they don't feel they know it as well as they demonstrated they knew it with the programed materials; and I think our students would tell you that they have learned from programed materials in English, but that they need some other experiences outside of it. This is the reason we have been developing supplementary materials, so that we are sure that students can make a transfer from programed to other materials.

"We think that group-paced use of programed materials with relatively homogeneous groups would work reasonably well, but see no reason for it. For then you are forcing everyone in the group to move along together and there are no children who really can be grouped homogeneously. You see, our clusters are really the only true homogeneous groups that you can find, we believe. That is, they're flexible homogeneous groups. Today, at a given time, five or ten students need help with a given thing, but next week that group is likely to be composed of several different students. This has been well documented.

"Programed instruction was designed to be used in the Continuous Progress Plan but, of course, programed materials really came first. We do think, however, that programed learning will not be used to its fullest extent until it is used in some kind of a plan, whether it be this one or some other, that permits students to move along at their own rate."

### COLLEGE LEVEL

I learned that BYU college students were using the high-school carrel classroom and testing facility at 7:00 a.m. and 4:00 p.m. The instructor was Loyla Walker and our interview was an interesting and informative one. She had served as an assistant teacher last year in the laboratory school on a graduate assistantship. This was her first year of teaching at the college level. I was further somewhat surprised to learn that they were using the TEMAC second-year algebra course (high school level) for their programed material. Miss Walker explained that the course was a remedial one and that the students taking the course had been identified by the ACT College Entrance Exam and had not attained the minimum acceptable score. From this I concluded that all her students were freshmen, but she further explained that there were a few others who needed the course in order to take something else.

"A lot of freshmen are in the general college and don't know what they want, so they are just exploring. We have some who have intentions of being engineers, but they have a long way to go because they are so deficient in mathematics. Actually, our students represent about every major in the university.

"Last year Dean Hill of the college physical engineering and science department got interested in programed instruction as a means for providing remedial instruction. He thought it would be a tremendous idea to try it on this level, and I know he talked with Dr. Read and the math teachers last year and asked whom he could have to supervise the program. That's how we got started here.

"We have some problems that I think they don't have at the high-school level. First of all, this is a non-credit course, and that in itself removes quite a bit of initiative that these students might otherwise have. Also, ours are not the very best students or they wouldn't be here. You hear them say, 'Why should I do it; it's non-credit. I'll do everything else first, and then when I get around to it, I'll do it.' So we lose quite a few students because of this. Next year the college is offering credit for it, and I think that that will take care of the problem.

"I'm very optimistic about the course and think it is a good program. We had 36 students that came in at the beginning of this year who were just lacking in a few things. They'd even had two years of high-school algebra but couldn't pass the test. These people finished the course in eight weeks, and then we gave them the final and they were through. We have another 40 that just finished up last week and now they are spending two weeks to review to take the final. The final, of course, is the entrance requirement into more advanced courses. And then we've got some students that supposedly will never really learn algebra, and so with them we are taking the course slowly. It will probably take them two semesters. They'll probably learn sufficient for their needs, and, most important, they won't be flunked after one semester because they just couldn't keep up.

"Each morning we have two different

groups meet in the small classrooms. The one that the assistant is taking is the slow group. He is still back on factoring, but I think they are learning it. We alternate in working with these groups. The groups were organized at the beginning of the semester, and later, if they go faster than a group or if they can't keep up, group members are shifted around. Students don't have to go to the group sessions. Some students like to go practically every day. Other students can read it as it comes.

"The main question asked by the students is 'Why not just work on the materials at home?' We feel that they get more help here. If they have a question at home and they sit and study it and it doesn't make any sense, they have to quit. But if they're here, they turn on their desk light and the assistant is right there to answer their question, and they can go on. Of course, they do a lot of studying at home – they have to keep up. This is a year's course on the high-school level that we give them in 16 weeks. Except, of course, the slow ones, who may spend a whole year on the program.

"Some students are really enthusiastic about the course. They say that it is the first time that math has ever been interesting to them. Generally that is the slow student that has never had any interest in math. There are others who can't seem to keep up and they get discouraged and blame it on the program. Their attitude is 'I don't like it, I don't want anything to do with it.' So, we have all sorts of reactions to it, but generally a very small proportion is disgruntled with it.

"I'd like to brag a little bit about the distribution of grades and scores on the final test. Last semester this course was taught traditionally in four different sections and, of course, it was taught here. I had half the students and they had half, and we found on the final exam that I had no students in the failing category. Of course, a lot of those who might have failed, received incompletes and are back finishing the program this semester. About three-fourths of them have finished and none of them has received failing grades. I had the highest percentage of A's. The other classes had about 15 per cent where we had about 25 per cent. The groups had been randomly assigned to the two sections. As a result of this, I know, next year in math they're going to use programed materials exclusively for this particular program.

"We're going to try to keep track of all students who complete the course, for another year, to see what happens. Probably the best way to tell whether this program is more effective than the other is how well students do beyond it. . . . I think next year we'll be able to show more outstanding success in the program. I'm thoroughly convinced of it but I still have to convince quite a few people on the campus, especially the professors in mathematics. They don't think this is the correct approach to teaching. They think that the important thing is instilling in the student the desire and the inner feelings. Yet, they're not interested in teaching this course themselves. They think that this is something that a graduate assistant can teach and so I sort of wonder about this inner feeling. Besides, these deficient students need to learn the rudiments rather than just inner feeling."

I had several reactions to the various statements. From what Dr. Read had said, one could tentatively conclude that *programed materials will work only as well as the total educational context will permit them to work.* It seems reasonable that optimum use of programed materials will require the development of facilities, schedules, and instructional and testing procedures which will complement the characteristics and capabilities of programed materials. If programed materials are simply bought and given to the teacher it is unlikely that they will be used efficiently.

Another observation was the obvious difference in the use of programed materials among teachers. Differences may have been due to different grade levels, different philosophies of teaching, or personality differences among teachers, but in any event, the attitudes toward, and the use of, programed learning materials appeared to be more tightly controlled at the lower grade levels. A fourth guideline might read: *expect widely varying use of programed materials depending upon student aptitude, teacher attitude, grade level and other factors.*

## The Teacher as Source and User of Programed Materials

The more I saw, the more I was impressed with the role of the teacher in what was supposedly instruction provided through programed materials. This, obviously, required further explanation. I asked Dr. Read, "When you introduce the materials, do you provide any kind of training for the teachers to use the programs, such as workshops or anything like that? How do you orient new teachers to your program? Who develops your tests and other supplementary materials?"

"We weren't able to have workshops," he said. "This next summer we are employing our staffs and will have them working with us on programed materials all summer. When we started this program, we got our materials actually after school started – some time in September. The teachers just had to grab it and get acquainted with it, on their own, with their students. But you see, we had no problems because our staff was involved in developing the plan. It was their plan and they were involved in testing the system to see if it would work. They had come to the conclusion that they needed programed materials badly and wanted these materials no matter when they could get them. They did complain that this was no way to get started; they needed time to get acquainted with the materials before working with the students, but there was nothing they could do but wait until the materials arrived.

"Teachers new to the school this year were familiar with neither the plan nor the materials, and they had a very poor start. The ones last year had been acquainted with the plan for two years and, although they had very few materials, they still could operate. But I think that you will find that in spite of the teacher situation, our students in mathematics are more positive toward the plan than they are in English because we had so few materials in English, and the materials we had we don't regard as particularly good.

"In our elementary school we devote about 80 per cent of faculty-meeting time each week to in-service education, and once each month we close school and have a half-day workshop. It's in these workshops and in faculty meetings that we become acquainted with the materials.

"As we see it, the teacher's role is going to have to be one of diagnosis and of evaluation. In addition, it will be that of a discussion leader who leads students to express the insights they have gained and to express them in the growing light of perceptions and insights that come from other people. The discussion enables each student to see the error or strength of his own reasoning."

Most of the information I received about the preparation of supplementary materials, such as study guides, tests, instructional tapes and other matter, came from the teachers who had been freed to work on the development of materials. At the elementary level, Mr. Ruel Allred, an experienced elementary teacher, gave me the following information:

"There are certain steps that any school will have to go through before instruction can take place through programed materials. We figure that there are at least five steps that should precede an attempt to teach through programed means. First, the skills and concepts to be taught must be isolated. Second, they must be sequentialized. Third, diagnostic means must be provided, either subjective or objective or both. Teachers must be able to find out which students need instruction and in which skills, etc. Fourth, it is necessary to have a record-keeping system, some convenient method of knowing which children have the skill and which ones don't — that is, some method of recording the objective or the subjective data. Fifth, you must collect or develop sufficient materials to teach those concepts and skills which have been isolated. We feel that once these skills have been sequentialized, a record-keeping system developed, and diagnostic means provided, then probably the skills and concepts could be taught in several different ways.

"Our general procedure has been to hold a planning workshop with the faculty. Then they turn the job over to us. We work it out and give the materials to them; they try it, evaluate it, hand it back to us and we make revisions. It is a project that involves the whole school and we're just the leg men on it."

At the secondary level, Mr. Lowell Thompson was working full time in developing curriculum materials with special emphasis on the area of physical sciences. I asked Mr. Thompson to describe the process of getting ready for programed instruction at the secondary level. The following was his answer:

"Our first thought was merely to get the students together for a block of time — a two-hour block with the science and math departments working together so that if need be, we could have the students for two hours for various experiments. It was thought that it would be best to have individual study stations for the students where they could study under supervision of qualified assistant teachers, and thus leave the professional teachers free to call the small groups out to instruct them when they needed help. This is probably the essential characteristic of the plan.

"Now, to keep track of the students, we developed a data-reporting form that they fill out and that indicates where they are in the programed materials. We had it worked out so that we could tell on a day-to-day basis how much work they did in class, where they were in a particular course, how much work they had done at home and whether they needed help. We developed a standard form that they filled out each day during the last three minutes of a class and handed in as they were leaving. Our secretary handled the testing and supervised the testing room. During the supervision period, she made out reports and recorded them in a notebook for each individual student; all we had to do was to look at the student record and we got a picture of where he was. Also, we maintained charts on the wall with little stick-pins and these would be brought up to date by the assistant teacher each day as a student took a test and had moved a certain distance through the course. As the pin was moved it would indicate whether the test had been successfully passed or whether he needed to go back and do additional work and take a retest. The system has worked quite satisfactorily. There are new teachers on the job this year and they naturally have different ideas as to what they need, so there has been some modification of it, which is to be expected. But the essential features are still pretty much the same.

"Certainly, we have to have additional materials. We don't feel that programed materials as such are the final answer in mathematics or any other field, because other things are needed to help the teacher spread himself out, so to speak, so that he can meet the different groups on a more or less personal basis – I mean such things as short, single-concept films, filmstrips, slides, and tapes. You have a number of groups that you have to meet and usually you can correct their problems and help them within 10 to 20 minutes. But still, there is quite a number of them that we feel need to be directed to filmstrips, slides, tapes, and other media. This helps relieve the teacher a little bit so that he can concentrate on more pressing problems, and seek out those who are really having trouble.

"Students become better at learning from programed materials. In fact, in their second year in the program, they sail along much more smoothly and accomplish a great deal more than they usually do in the first year. We can pick students up at their point of readiness if the program functions as it should, and we hope it will. There should be little time wasted as far as the students are concerned, and little excuse for their coming to a lecture and discussion that is either over their heads or below them. In the long run I feel that it will be a much more satisfying and interesting way of teaching, and certainly no more work, because even though you're meeting a large number of students there is an economy of time because of the clerical and assistant-teacher help with the busy work, the paper correcting, and this kind of thing. The method of teaching becomes very challenging because at any one time you may be asked questions or you may have to help someone at any point in the entire course. You get away altogether from this idea of the teacher staying just a day or two ahead of the students! Once you get into the program you have to keep yourself abreast of the entire field. That is why I say, once you are oriented, it is much more satisfying. You feel that you are really a professional teacher and that you are competent to answer the questions in any area that you might run across.

"It's wrong to portray this as being an accomplished fact in the Continuous Progress Plan because it certainly isn't. As I see it, the next two or three years will be spent largely in getting materials ready and gaining a degree of competency in this new way of teaching. Beyond that it will be a matter of setting up a research design for testing the plan, trying to see whether it does offer advantages and whether the end product is more desirable than what we get out of the traditional school. So we have a lot of testing that has to be done on the program before we are justified in making any claims.

"The first year we used programed materials we told the students to do whatever homework they thought they needed to do and not pass up anything they felt they needed additional study in, but at the same time, not to do just a lot of busy work. We told them they were going to have to take a test and would have to judge whether they understood the material or not. It was amazing the amount of homework that they did when they finally realized that we were not requiring them to do any homework, actually. We were requiring them to come up to a certain standard as far as performance and tests were concerned. If we had assigned them the number of problems they turned out as homework, we'd have had a rebellion on our hands.

"Also, starting on the secondary level with students who have been in the traditional mold for a number of years, there is a problem in adjusting to a new program. We think that the traditional school has done more to kill initiative than it has done to help it. If this kind of program, or a similar program, can be instituted, so that children right from the start of their schooling have to take quite a personal interest in their own advancement and responsibility for their achievement, we think that when they reach high school much of the motivation problem will be licked."

From what I had seen and heard, several additional tentative guidelines suggested themselves. From the amount of time being devoted to curriculum building it appeared that *a fully defined curriculum scope and sequence is required before programed materials can be selected or developed effectively.*

There is no denying the fact that the teacher's role is modified when programed materials are used widely. Not less, but *more teacher time is required to teach with programed materials. Teachers can be assisted by assigning clerical duties to clerical personnel.*

The new role is not simply one with more of the same kind of teaching, as in the past, but one that is characterized by different emphases. *Teachers will need additional opportunities to become increasingly expert in diagnosis and evaluation of learning.*

## Effectiveness of Programed Instruction

### THE TEACHERS' VIEWPOINT

The clearest statement of the effectiveness of programed instruction came from Louis Chatterly, a master teacher in secondary mathematics:

"We are solving the problems extremely well for advanced students – those that desire to go on as quickly as possible and don't want to wait around for a lot of slow people to catch up with their thoughts and ideas. On the other hand, where the student is extremely slow, but desires the knowledge, he is given the opportunity through programed instruction to grasp the knowledge at his own rate of speed, rather than try to keep up with students that are much faster. The middle group, which is the largest, of course, is doing as well as the conventional classroom group, but maybe not any better. Our judgment will have to rest on the statistics that are being gathered on the upper campus. We really don't have any basis yet upon which to base this opinion, but this has been our impression."

I went to Dr. Read for objective test data on the effectiveness of programed materials. I inquired who had prepared the test instruments and asked him for any other information he could give me that related to the effects of the materials. I discovered my questions were premature.

"We have tests for the years before we started, the year we started without programed materials, and the years since we have had programed materials. In the year 1960–61 we kept extensive records of tests and summarized them. We used programed materials in the year 1961–62 and gathered test results. I went into the hospital at the end of the year and the tests have never been summarized. Complete test results are being accumulated for 1962–63 and will be summarized so that we will be able to provide test data on the effectiveness of the programs. However, this work has not been completed as yet. It will take some time to summarize the data, but we know that the students have been achieving well. Before we will really know anything, however, there is a big job of statistics that will have to be done.

"The tests were simply standardized tests – the cooperative English test, the cooperative mathematics, and the STEP test—straight standardized tests to see how our students compare with national norms.

"Now you ask if there were varied reactions from teachers. I think I can honestly say 'No,' and you can verify this when you get to the teachers. They believe in programed material. At least, I could safely say that they believe in the Continuous Progress Plan. They know that the plan requires programed materials and other learning resources that can be used on an individual basis. I believe you will find that, although they have faith in programed materials, they are very critical of the programed materials that are available. They really haven't found any material yet that they are satisfied with, but they believe it has a future."

Donald Peck, another master teacher in the secondary math department, gave me some information about another kind of evaluation.

"We as teachers do miss the conventional classroom, where we can lead the kids from idea to idea throughout the course. Now, the programed material does this for us and all we do is help them in their problem areas and through difficult concepts, rather than leading them from idea to idea. Another point is that you're not able to prepare for any one subject at a time. You might have in one period anything from an elementary algebra problem to a college trig problem, or even a calculus problem. This means you certainly have to know your subject. You couldn't have somebody who is trained, for instance, in home economics, teaching mathematics; it must be a person trained in mathematics. A person who is trained to keep ahead of his children by one jump is doomed to failure. It just can't be done, because the kids move faster than you can anticipate in many instances."

When I asked, "Do you think that programed materials can help relieve the teacher shortage," a pained expression was my answer.

"This is sad. Many people are looking to programed materials as a replacement for the teacher. In our experiment that we've been running here, it can hardly serve as a substitute. Somebody's got to be around who knows what he is doing and be able to help the student at whatever particular place he is. It's a difficult job. They hit you cold with a lot of these things sometimes.

"I just don't think you can substitute for the verbal exchange between student and teacher, or between students themselves, with what a student reads in a book. He needs this experience of verbal communication as well as the programed material. It is like anything we explain. I once heard a physicist say that he went home and tried to explain a concept to his wife. She didn't understand, but in the attempt to explain it to her, it became clearer to him than it had been before. In attempting to explain, one is forced to think more critically and thus often gets new insights in the process.

"I know many people that come here to visit us think that this is going to solve all their teacher problems and their teacher shortages. This, I think, is the biggest fallacy that has come out of this. There is no substitute for the teacher. There are points in mathematics, and even in the programed materials, where the student needs more explanation and deeper insights into the concepts than the programed material gives him. Whether or not they will ever develop programed material to do this, is, as yet, unknown, but we do not feel that they will. Our experience indicates that children are too variable for anyone to write a single program that fits every single child. The teacher needs to be there to interpret a child's reaction; to be able to help him over those points where he has difficulty. If programed instruction is ever to be adopted by schools in general, I think they are going to have to realize that it is going to cost more than the conventional type program. Teachers are going to have to have more help. A teacher can't possibly handle students spread from one end of the curriculum to the other all by himself.

"We found out, too, that a lot of the districts that have come to see us have teachers steeped in conventional methods of teaching and with no real background for programed instruction. The administration simply wants to hand them these programed materials and say, 'Do what you can.' I think nearly all the teachers – not all, but nearly all of them – have had a defensive attitude toward programed teaching because all they can see is more problems for themselves.

"For example, we had a teacher come down from Idaho and he said his superintendent wanted him to jump into it before the end of this year. Well, just to set up the testing program for one class would take a whole summer of work for him. Yet, the superintendent wanted him to introduce programed materials during the last three months of the year. We told him to do anything – get down on his knees and beg, if necessary – but not to attempt the job because it would create attitudes toward programed learning that they might not be able to overcome.

"The two of us, our secretary, and two graduate assistants, are barely able to keep our noses above water and this is handling a normal class load for each of us. We normally teach about 150 students a day, or a total of 300 for the two of us. You don't realize what happens when you start picking up 40 exams a day to correct, and this is every day, and they cover a wide range. It isn't like making up an examination that you give to your class once and then it is all over. It's every day. You find, too, in making up these exams that they must be made up carefully because once you run them off on the stencil and ditto machine, they've got to be used over and over again. You don't have the opportunity, as you do in a conventional classroom, of simply noting that there is a mistake in problem 2 which should be corrected on the exam papers. You don't have this opportunity because all the tests are made up ahead of time in this program. The tests must be prepared so that the student can take any test in the total range of his course, and that is obviously a heavy burden on testing.

"As far as the students passing along information about the tests to other students, there has been a problem in this area. We used to have children going in to take the tests just to get a look at them. But then we started to average the grades they received on all the tests they took, so they don't do this quite as often. And usually all that a student finds out about an exam from the other students is that it is particularly difficult or not so difficult; not the questions. After all, it is the same stuff that they've been studying. I think, probably, knowing children, they do pass on some kind of an idea about the particular concepts that are involved, but the concepts usually are pertaining to the instructional unit anyway and as a result, they are going to have to bone up on the material that is involved in the unit they are studying. This is the case even when they get help from other students and know what types of problems are involved. The students are required to show their work and everything on the test, so we haven't experienced any real difficulty that we know of with this type of information-passing. I don't think it is very serious, judging from the difficulty they are still having with the problems on the tests. They cannot be getting much help from too many people."

I asked David Lindstrom and Anna Hart, two master teachers in the English program, to describe and evaluate programed learning in the field of English. Mr. Lindstrom, chairman of the English department, explained that they had a six-period day; that the first two periods were planning periods for him in which he drew up schedules, checked papers and did the conventional teacher planning. During the third period there were about 105 students in carrels, approximately 65 of whom were ninth graders and the balance tenth graders. During the fourth period eleventh and twelfth graders were together. During the fifth period the balance of the tenth and eleventh graders that were not in the third period were assigned to the carrels. The sixth period was again free for planning.

Mrs. Hart had the first period for planning, but during the second period she had eighth graders in a reading class. The third period she assisted with 109 students in the carrels, helping them with individual problems and answering questions. A college graduate student worked with her. During the fourth period she had a seventh-grade class whom she taught study skills and how to work individually. In the fifth period she assisted in the carrels with the tenth and eleventh grades. The final period was for planning. Mrs. Hart explained that there was a range in ability in her eighth grade from the fifth grade to the junior level in college. In the carrels, one teacher is responsible each hour for approximately one-half of the number of students in that class. The students are divided into ability groups. The 65 ninth graders, for example, had been divided into five groups, depending upon ability level and how fast they were able to advance in the program. They were scheduled so that a teacher met with every group twice every two weeks — once for lecture sessions and discussions, and once for grammar in creative writing assignments.

Lectures were tape-recorded and when students arrived at certain points, they listened to the tapes. They could dial the lecture they needed; generally the lectures were about half an hour long. I asked Mr. Lindstrom how effective he considered the program to be. He replied:

"We are a year ahead of the public schools in Utah. In the ninth grade we study types of literature. In the tenth grade we study American literature. In the public schools they don't get American literature until the eleventh grade. In the eleventh grade we study English literature and in the twelfth grade we have a two-year course in world literature, which is quite unique. Some students get one year in the twelfth grade in world literature. When they finish that course, they have their choice: they may finish after that one year or they may go on to a second year, where we cover the Greek, Roman, and Latin literatures. It is a long-lasting thing. The kids can go just as far as they want in the program.

"One of the comments I get from some of my students is the fact that when they want to study for tests, it is very difficult to go back and spot a particular rule in programed materials. The complaint is that they need to go through all the frames again. I think it may be a weakness in programs that there is no fast process for checking rules and things that one may want to study for tests.

"As far as effectiveness is concerned, there is one student in the ninth grade who has completed over a year-and-a-half's work in grammar. He has completed *English 2600* and *3200* and he's completed the eleventh-grade workbook, which is called the *Workshop;* next year he'll be going into twelfth-grade grammar and will do his research paper. He actually has the choice of doing that next year – he can also put it off until the eleventh or twelfth grade, if he desires. His comprehension is very good and if he can stay up to this level in his literature, finish by the tenth or eleventh year, this would give him a year when he may sign up for any other class. He can skip English for a year and a half or two years, depending on what he accomplishes next year, or go into journalism classes or some of the other specialized skill areas, or pursue deep reading in certain other areas."

Mrs. Hart indicated that she was amazed at the high grades the juniors make on their tests. When I asked her who made up the tests, she replied:

"The tests are made up by the publishers and the personnel in the testing room are in charge of the booklets. One negative comment that we ofttimes get – and possibly this is due to lack of assistance – is that some students feel we are not able to move them as rapidly through the program as they would like to go. It is possible for everyone to move themselves through the program as fast as their ability permits but they may not be motivated enough, you see. They might not move themselves as fast as they are capable and the parents then say the children should be pushed along faster. Remember, in our literature program we are required to give a lecture and a discussion. Students must complete creative assignments, take tests, and so forth. You must realize that with 65 students, or whatever number may be assigned, all on their own, there is going to be a little overlap and a little lull for some students. This is an area that needs to be looked at pretty carefully. You see, many of these students have come out of the conventional system where the teacher tells you you're going to do this exercise and we want it done by tomorrow, etc. So it is quite a change for them to come in and be on their own now.

"During the first year we took over six weeks to teach just skills of how to study, how to work in the studio, etc., but the parents began saying, 'When are they going to learn grammar?' You see, all during these six weeks we were teaching them listening, reading, and writing skills, how to study, how to take a lesson, how to plan an hour in the studio – and we found that we had to have some kind of a schedule, had to form groups and keep them within a group. Even within a group they are at different places in the program and it is a great amount of work for the teacher. I have worked harder this year than I have in six classes in the conventional system. The responsibilities are terrific."

Mr. Lindstrom added:

"I need to be prepared to lecture and discuss all material anywhere from ninth-grade material to twelfth grade. I no longer specialize in American literature or English literature, but have to be able to go through the whole program."

Additional information on the effectiveness of the English program came from interviewing June Whiteford who had been head of the English department but was now spending full time developing the English curriculum. She explained:

"In using standardized tests teachers found a statistically significant advance over what has proven to be a normal amount of acceleration for a year's time. There were two heterogeneous groups and two homogeneous groups. The homogeneous groups were advanced students, while the heterogeneous ones ranged anywhere from a 75 IQ on up. Some students had done two and three years' work in a single year. There was that much of a range – from seventh grade in ability to the sophomore and junior years in college, according to tests. There is no way of measuring on the literature – there are no objectives or tests. But in grammar there are, and we found out that the advancement of students with the programs was greater than we could normally expect.

"Evidence which came to us through another source, and one where we had no control over the figures, was the report sent down from BYU on their college entrance exams for freshmen. Our people were 8 to 10 points higher, on the average, than the high-school norm of entering college freshmen. The norm was 18.7 and our people were 25.4. The students in our lead group were 28.2. Further, none of our people were placed in 'bonehead English.'

"We have had some complaints from parents, most of them based on misconceptions of what we're trying to do. Many of them were afraid that the program was only for the advanced, superior students. But we are very much aware of both ranges. We find that actually the frustrations of the lower students are lessened because of several things. First, you know which are your basic concepts – the ones you must stress and the ones you don't need to push so much with certain students. Too, you can change the level of abstractness or concreteness in your instruction when you have small groups. I never give the same lecture in the same way twice because I have different groups and what would be *à propos* for the lead group would not be what is needed by the slower groups. A major concern of many people was that the program would ignore the skills and the time needed for the slower groups. But as a matter of fact, you can give the slower groups the drill and instruction they need, as well as the patience, without boring your top students.

"From the teacher's point of view, I think there is no question that this is a superior approach. I doubt if I could really go back to teaching the other way without feeling guilty. One thing I think of often is the amount of energy that this program has taken. It is phenomenal. Many of us are exhausted, but what we need is more materials. We need completely individualized materials. We need a wide range of them and a large reserve so that we can assign different materials to different students. Our department has been trying to see if it couldn't arrange these strands of concepts and get them down to the point where they can be programed. We've been trying to do it alone, but it's a tremendous amount of work. If some foundation were to develop a complete set of English curriculum materials, K through college, there would be a demand for them and a willingness to cooperate on the part of English teachers all over the country. I know I've explained this program – what we've been doing – to literally hundreds of teachers and supervisors who visit us. There's probably not a single week that we've not had two or three groups coming through, and I have found that the more versed, the more experienced, the more energetic, and the more capable the teacher, in my estimation, the more enthusiastic and willing he was to see how these materials can be used.

"I haven't had real discipline problems since we've started using this system, simply because students in small groups know that you're interested in them and that you are trying to show them something. I've even had students stay five to ten minutes after the bell rang at noon."

Another kind of evaluation came from Mr. Morris, principal of the elementary school.

"We have had a great deal of support from patrons," he said, "from teachers, and from students in the elementary school. In fact, we have so many patrons who want to get in, we just can't accept all the students. I have processed over 500 applications within the past few weeks. We have people calling on the telephone, some of them long distance, asking about the program. I had two calls from Salt Lake City in which the people were so interested in having their youngsters in a program where they could progress at their own rate of speed that they were willing to move from Salt Lake City to Provo, just to get their youngsters in the lab school where they could have this type of program."

As I continued to visit with people, it became increasingly clear that there was a relationship between the amount of materials available and the satisfaction of the teachers with programed instruction. While there was no substantial objective evidence on effectiveness, there was a consensus that *a wide range of programed materials are required to instruct students of varying ability.*

Effectiveness is not constant even among students of comparable ability because of widely varying differences in motivation, study skills, and work habits. *Effective learning cannot be expected from all students with programed materials, even if they have the ability.*

I was duly impressed with the increased requirements on the academic knowledge of teachers. *Teachers will need increased academic competency to meet the demands of advanced students.* While programed materials probably will increase student learning in a classroom even with an ill-prepared teacher, the teacher who cannot interact with students on increasingly more sophisticated levels will become less and less useful.

### THE PARENTS' VIEWPOINT

In an attempt to get firsthand information on parent reaction to the extensive use of programed instruction, I visited the homes of some of the parents whose children were currently involved in learning from the materials. Mrs. Paxmon was the mother of several children in the BYU lab school. When I asked her how many, Mrs. Paxmon's reply was as follows:

"I've had seven in the school. Right now I have children in kindergarten, third, fifth, ninth, and twelfth grades. Annette is the fifth grader. She's used these materials and she's brought them home. The way they learn mathematics now is quite different from the way we learned it. I'm not sure I could do it, but I'm delighted that she can.

"Annette gets very excited about it but she doesn't spend a great deal of time with it. She'll come home and tell me how many pages she's done and who's ahead of her and who's done more pages than she has, you know, and she feels an incentive to do as many as some of the other girls are doing.

"I can't think of anything negative about the program at the elementary level. I'm sold on it where the children are introduced to it early in their school program. But I have mixed feelings about my children in junior and senior high schools. I think they were introduced to it a little too late and their study habits were set, so learning in the carrels with their own motivation was difficult for them, and they haven't yet quite adjusted to it. And I think there's been a little resistance on their part. I hear them say, 'I just can't do it,' and then I hear a lot of criticism.

"I'm not criticizing the teachers, but my children all tell me that one of the real weaknesses in the program is that when they're ready to move along, they have to wait too long for their tests. You see the teachers are supposed to give them their tests when they're ready. If this is going to be a progressive thing – programed learning at each child's speed – the children should be able to take their tests when they are prepared to take them. My children say 'Well, I was ready to take it on the short story,' or, 'I was ready to take it on lyric poetry and I put in my request, but I didn't get my test for a week or two.' I'm exaggerating but anyway, a long time. And then the students say, 'Yes, but by the time I got my test, I'd forgotten what I was prepared to do.'

"Then there is another criticism. I do think that the recall on this type of learning, at least with my children, doesn't seem to be as good as where you have the teacher and go over it and over it, maybe trying to help the slow learner. I think they retain it a little better. Now the only reason I say this is that when my son graduated from high school, I think almost a straight A student, he went up to take his freshman exams in English at the University and couldn't remember his English grammar because he hadn't been drilled enough in it. Now this may be a situation that we have in our family and maybe it doesn't happen to other students, but I think they need a little more drill in some way. This doesn't hold for my younger children at all, they just really eat this programed learning up. It's just fine for them.

"Oh, yes, we parents discuss it some. There are mixed feelings about the carrels. Some children adapt themselves to this beautifully and others don't, but I don't think this is a problem of the system, just an individual problem.

"It really is a wonderful thing. I can't see why it shouldn't be successful. And there's only one other thing that I really feel is unusual about this. When I look back on my own learning in high school, what I remember are the strong teachers who inspired me to learn. You know, learning can be very exciting if you have a teacher who makes it exciting. In this programed learning, I wonder if there is enough contact with the teachers so they can give this feeling to their students?

"With some children the same kind of excitement that comes from strong teachers could come from programed materials, but you'll have to be rather mature before you see the excitement of just learning for knowledge's sake."

In another conversation, Mrs. Robert W. Petty expressed some different viewpoints toward programed instruction. As a member of the executive board of the PTA council and the mother of four children in the laboratory school, she had had considerable exposure to programed instruction during the past two years. She began by telling me about her son, Jimmy, who is in the ninth grade.

"Jimmy has brought quite a bit of the material home. Most of the children have used it at school, with the exception of Jim. It seems to be very good. I'm more impressed with it in the younger grades in that it's conditioning them for the older grades.

"I think the other parents have pretty much the same reaction – those with students in high school right now, who started out sort of cold, thought it was too hard on them. Their children couldn't do it, didn't do it, and wouldn't do it – a few of them have adjusted and seem to progress very rapidly – but the over-all picture, the general opinion is that they'll do better if they have the background that precedes it.

"Even the parents of the children who aren't getting along very well, don't think their children are not learning something. They think that their child probably progresses like the average child in the graderoom situation, but they wish their children had been conditioned for it sooner.

"But I think the program is good; it's the best preparation I can think of for college work, where students have to work on their own, without being pushed or whipped by a grade or something like that.

"It really puts the initiative right on the child. Now I have a daughter, Janice, in the second grade who's getting programed instruction and I'm just thrilled to death with what she's doing, because she challenges herself to get a little bit further every day. It's the same with Douglas in the fourth grade. I have another daughter, Suzie, in the sixth grade, then Jim in the ninth grade, but the three in the lower grades will be far superior students and better prepared for this kind of learning in high school than Jimmy was.

"In a way, I think it's hard to pick out the negative qualities of the program because it's so new. I can think of a lot of them as far as Jim is concerned. He needs a teacher to keep prodding him constantly, but I think by the time Janice gets into high school, she won't need that kind of prodding.

"One particular thing that I think the parents have been a little concerned about is that they haven't known how to encourage their children at home and they haven't known when to tell them to push or when to let go. But this year the teachers came out with a new system which indicates what they expect of the student, based on his past efforts, and they have called the parents in on it. Sometimes their expectations are a little higher than the student can go and sometimes they are just where the teacher thinks he can go. But until then, I didn't know whether Jimmy was doing as he should do or how he was progressing, and until I saw that he was behind, I didn't know what I should say to him, but since then I have been able to say, 'all right, Jim, are you up where you should be?' and that way we've been able to work a lot more efficiently.

"Cynthia doesn't have any of that, although I know approximately what she should do and she's behind what I feel she could do. Now, sometimes I think maybe I'm a hard taskmaster, but she's doing very well in English and in writing and in reading as far as I know, but in this arithmetic, which she doesn't like anyway, she's just moving very average, I think. I believe if you give children an inch, they'll take a mile, unless they have the push and understand really what their goals are."

I checked with the two master teachers in the high-school math program and asked them about the problem of informing parents what was expected of their children. Mr. Peck said:

"We have inaugurated a program with the counselors in which the parents of every child involved in the experimental program will be called in and given an outline of some of the materials that the student is going to cover during the year. Then the parent also knows the goals that the student has. This way we hope to alleviate some of the problems with the parents. These have not been many, but still the few that we have had have been from a lack of communication in letting the parents know exactly what's expected of them and their children. We have had conferences off and on, particularly with those students who are not doing a very good job, not because they didn't have the abilities, but because they did not have a desire to go ahead on their own and accomplish the things that they could do. Some of the parents felt that because the students are left on their own, there was a lack of motivation for the student and they didn't like it.

"One parent called up and his first statement was, 'I want you to know, before I come in, that I am a definite enemy of this program. I'm probably one of your most severe critics because I just don't think it is accomplishing the aims and the desires that the administration wanted it to." Now his daughter was really unmotivated, so to speak. We had been after her all year, trying to get to her, and had sent letters home to her parents several times during the year. This was the first contact, though, that the father had made with us. Before he left, however, I believe he was inclined to agree that the program did have merit, and that probably some of the fault lay not only with his daughter, but also with them as parents. In other words, there was a lack of communication between the parent and the child, as well as a lack of communication between the school and the home. I don't believe he left as severe a critic as when he came. We have found, in general, that students of high ability and their parents have been extremely pleased with the program, especially when the students themselves want to get ahead as far as possible, or when their parents want them to."

As Mrs. Petty was saying, when parent and child both know what their respective roles are in learning from programed materials, everyone benefits. It will take considerable time for schools to develop more efficient information systems and to prepare parents to help their children get maximum benefit from programing, but the result can be a significant advance in programed learning. *Parents must be given an opportunity to learn their role in helping their children to use programed instruction to best advantage.*

### THE STUDENTS' VIEWPOINT

I questioned dozens of students. I had graduate assistants and teachers point out students who were doing exceptionally well, those who were least successful and most negative, as well as the mythical "average." The following are selected comments which have helped shape my general impressions.

Linda Jacobs was just finishing her junior year in high school. From what I had learned up to this point, I had concluded that there were many more programs in mathematics, and that programed materials were much more successful in this area than in that of English. I asked Linda, "How's it going?"

"I'm doing better than most in the regular grammar. Of course, it depends on the person. I don't think the kids goof off a lot in the carrels. They work on what they're supposed to, at least in the periods I've been there they have. I think the system works for certain types of people, and it definitely doesn't work for other types. I'm the type that likes to work with people and I learn much better from people than I do from things, but I do enjoy the system. It will really go far for the right type of person. Now, for math, I believe I'd much rather have a regular class than programed materials, but it's okay for English. I do much better in English and like this way of learning, but in math I'd learn better from the teacher and discussion."

The problem of student variability apparently is increased with programed materials. It is certainly not lessened merely because students can take more time on the materials, which has been a major argument especially in favor of the slow learners. Linda was not an isolated case. I am quite certain there is a normal distribution of opinion and achievement among students engaged in each subject matter area.

David Shaw, also a junior, had been a public school pupil last year and was just completing a course in American literature. I asked for his reactions and for his opinions of the reaction of other students.

"I think it's really a good program. I've learned a lot here – more in the first quarter than I learned in two years in any other place because I've had time to buckle down and work. Over at Provo High, where we had class, it just seemed like it dragged along. I could understand everything they had but it was just boring to me because it wasn't up to what I could do. I came over here and I've just sped along like crazy. I've finished American literature and I'm halfway through English literature and I've learned an awful lot – I mean you just dig into these pages and you learn a lot more than you ever learned before.

"I've heard some smart cracks from some of the guys. I don't think they apply themselves well. They just go into the carrels, sit for a while, think that it's time for a rest. I know sometimes I've gone into the carrels and slept too, because I've been real tired, but I've learned more, over-all, than I have in any other class I've ever taken."

Much of the information I had received previously had led me to believe that the elementary-school children learned to adjust to programed materials more readily. However, the motivated learners like David, who were in the program for their first year, had made a very rapid adjustment, were completely satisfied with the program, and were making excellent progress academically. David did say that sometimes the programed material got monotonous and he thought they needed to build some "spirit" into it – like they have in a classroom – but he didn't know how it could be done and said that not all classes had "spirit" either.

Martha Whitaker was a sophomore. She had completed four programed courses in mathematics, as well as English grammar. I asked her what she thought of it.

"Oh, I like it very much. It can get boring if you're not interested in the subject, but if you have enough interest, I don't think it's boring. I enjoy it thoroughly. A lot of kids complain because there's no class. The ideas of the other students in the class aren't brought in, or something like that, but – well – I like it because it gives you a chance to move ahead and if you don't understand, there's always a teacher there that you can ask. But if you do understand it, you don't have to worry about whether the other students in the class understand it. As far as I'm concerned, I like the math program much better than I like the English, but I think our English programs would be helped a lot if we had programed materials and literature too. It's awfully hard to be put in the carrels and told to work at your own speed and then have to work out of a book that's made for a classroom. We don't see our results fast enough in English."

As Martha spoke, I realized for the first time how we have, largely through necessity, conditioned students to wait between the time they make their response as learners, and the time we advise them of its adequacy. It is only after a person has worked in a situation where he is informed immediately of the adequacy of his response, that he comes to expect this kind of immediate information and begins to register dissatisfaction with what so far has seemed like a reasonable and necessary delay. Certainly, every teacher needs time to score papers and so forth, and it would be unreasonable to expect a paper back as soon as one has written it. Yet, after students have had some experience with programed instruction, they come to appreciate quick knowledge of results and to expect it in other subjects.

Elaine Morgan, a ninth grader, told me:

"They're wonderful courses that you take in the carrels because you have a lot of time to yourself and you can really go as fast as you want. You don't have to worry about what everybody else is doing and you don't have to wait if you want to go further. In

English they've got good enough teachers, but in math they have powerful teachers that will make you go and that make you want to go. You have to have teachers that make you want to go. Even with the materials, the teachers make a lot of difference. At the first of the year, they set down the rules in math and they say, 'well, if you don't get it done, it's your own fault and you're going to have to come back year after year until you finish it.' But if you don't do the work in English, they just say, 'well, that's all right, do it next time.' You have to have somebody to make you do it, to really check up on you."

Because of the limited programed materials in English, it was obviously not possible to have the more systematic procedures for recording student progress, and the quantities of materials in the creative writing assignments posed additional problems for tracking their progress. Nevertheless, the need for external incentives – such as a teacher's interest in a student's progress and the knowledge that he was being carefully followed – even though the student is essentially responsible for his own progress, became increasingly clear. The teacher's role is obviously not only one to supply additional information not provided by programed materials, but also to reinforce industrious behavior, creative behavior and other objectives which are valued by school and society.

I was supported in my conclusions by two additional interviews. The first was with Susan Peterson, a sophomore.

"Well, for math, I really like it. I think it's a real good program for math and with the equipment we have, it's really effective. But for English, there are too many things to cover and not much good equipment. I just don't like it at all for English. I don't feel like it's teaching us as much as if you were just in a regular class. A teacher that is teaching English in one of these programs should be a teacher that can push the students, because I feel that the students have too much a tendency to procrastinate and work on other materials in the carrels."

The second interview was with a student who wasn't doing so well. "What's wrong with it?" I asked him.

"Well, for one thing, you're not being pushed hard enough. You just sit there and do anything you want to do. I've lost credit out of math because of it and don't think I'm really that dumb. I don't know – I just couldn't get going on it. And I just sit – come to school and be tired and just lay my head down, or something. I think it would be a good idea if they kind of gave you a basic idea of what it's about before you were put in a carrel."

It should be noted that, in the mathematics department, the distribution of materials, checking on student progress, correcting of tests, recording of test grades, etc., was done by graduate assistants, not the master teachers. The master teachers spent most of their time actually helping students with math problems and in small-group instruction, not in the kind of housekeeping tasks which the teacher must perform in the typical classroom situation. I had the impression, though, that in doing some of these tasks, the teacher does have an opportunity to interact with the students in many ways. While it is unquestionably more efficient to use teachers as teachers, there may also be some loss of personal contact between teacher and student which is urgently needed by some students. This is to say, some students undoubtedly obtain satisfaction in working with the materials and the ideas; some obtain satisfaction from interaction among their peers; and some find the greatest satisfaction in acceptance by certain kinds of authority figures.

Steve Wood summarized the problem of the unmotivated student quite succinctly. He said the following:

"If I buckle down, I could do it a lot faster. But, when I'm by myself, I mess off too much. Sometimes I guess I find a problem and just don't sit down and try to work it out. It's not the teachers' fault. I think they try and do their best, if we have a problem and take it to them, we sure get cleared up on it. But the teachers outside of the carrels maybe have a little more advantage because they see you more often. The year I came here – two years ago – a lot of kids transferred and went to the other high school because they didn't like it, but I think the kids that belong here are the kids who want to buckle down and do something."

Almost without exception the reactions of teachers, parents, and children coincide. Just who learns from whom is not too clear, but it is clear that the children verbalize their perceptions as effectively as many adults.

My biases toward commercially available materials have been modified considerably. I still believe, as do the users of programed materials, that there is both great need and room for improvement of these materials. But conventional instruction is not perfect either. Present materials do permit the establishment of new instructional arrangements which have certain advantages over conventional procedures. If the new arrangements are more widely adopted, the demand for programed materials is likely to increase, which hopefully will result in more materials of high quality.

## Problems, Prospects, and Guidelines

A final interview with Dr. Read gave him a chance to add a few significant points. The first relates to the problem of articulation between high school and college. I asked Dr. Read, "How about your bright students who are able to finish in, say, half the time of ordinary students? What's going to become of them?" Dr. Read replied:

"If the student is well rounded, mature, and has completed all of his subjects at the same time or about the same time, he will either go on to college, if he is admitted, or he may stay in high school and take advanced placement courses and get college credit, and then actually go on to college when he is a little older. There is research to indicate that the young student who finishes early and goes on to college has great success. Others might be too immature, but the plan is flexible enough so that they can take advanced placement courses in high school. I don't think we should forget, too, that it is likely that many students who do finish early will finish some subjects earlier than others, and will continue with some high-school subjects while carrying some advanced placement courses in other subjects."

My next question was, "What about the other extreme? What is going to happen if a student spends four years in the ninth or the tenth grade and has only completed the equivalent of the tenth grade? Does he stay in school or does he leave with what information he has?" Dr. Read answered:

"As we see it, he would have no alternative. He could quit then and receive a diploma that indicates what he has done and at what level of competence, and it might indicate that he had worked at his capacity, in our opinion. Or, he could stay on and work through the curriculum. We believe that a student who has worked at his own rate and reached a high level of achievement knows more at the end of twelve years even though, say, he has covered only the tenth-grade curriculum than if he had gone through twelve years of curriculum at a less-than-satisfactory level. We say he knows more, is a better student, has better study habits, and has a better character. So, actually, if he should leave with a diploma after completing the tenth-grade curriculum he would go out a better student and make a better citizen than if he had been allowed to slough through twelve years and go out knowing very little. We find a lot of people agree with this idea.

"Of course, I know that some students are dissatisfied with the Continuous Progress Plan. For example, a seventh grader indicated to me, in a moment of honesty, that while he was making good progress with the programed materials and generally liked them, they could become pretty boring when that was all you had. I had students on the senior high-school level indicate the same idea to me — that programed materials could become a bit tiresome when they are all you have, and that they don't believe they are learning a great deal. Now I think that we have to recognize that this is a pretty common reaction. My own experience and that of the people who have written programed materials indicates that it is fairly common for a student to feel that he hasn't learned anything because learning comes so gradually and so easily.

"We have two problems of real concern; I guess the greatest requirement is that students be able to study — have correct study skills. The responsibility of learning goes to the student. Now the question naturally arises, can students develop this kind of responsibility? We believe and have shown that they can. We have also found that some students won't, mind you.

"When you have a student who doesn't want to achieve, I guess you don't have any greater problem in the Continuous Progress Plan than you have in a typical school. Some people think that just being present in a classroom — that is, being exposed to the instruction, to competition from other students, etc. — will keep a student at least close to the subject. But if he is in a carrel by himself and there is no pressure to keep moving — if he wants to daydream or read a magazine or just look into space, there is nothing to prevent him from it. But I don't agree with that idea. I tell you, in a traditional school he also dreams away in a class. He's herded from one class to the next for six or seven periods a day and he sits and dreams. He knows when a test is coming and if he is really motivated by a test he crams for it. If he is not motivated for it he takes a D and goes on. He is pretty sure he is going to move on year after year anyway.

"Now this is the kind of student the teacher has to threaten and punish to get him to learn anyway and we know punishment isn't a very good motivating force. And despite our best plan, we are still faced with the same student. But now he is in a study station or carrel of his own, and he often wastes a lot of time. However, the assistant teacher's job is to check within the carrel to see how he has done and if the student is not doing much, his job is to consult with the teacher. The teacher then arranges an interview with the counselor and the student. And then we bring in the parents and tell them this boy isn't doing anything — in other words, we have a counseling approach to motivation rather than a punishment approach. This takes a lot of time and a lot of work but it pays off. We have had unmotivated students become motivated and develop into real scholars, but we have also had some that just haven't developed into anything. We don't think the loss is any greater than that in a traditional school. On the other hand, we have a built-in motivating factor which we think is very important and that is that the student knows that he'll get as far as he works and makes an effort to get.

"You have asked me what might be the greatest weakness or problem in the Continuous Progress Plan. If you have the materials I don't see any weakness, but if you don't, then the teacher has to lecture and hold discussions and do this in small groups, and she can't stretch herself that far. If you have a sufficient amount of materials so that the prime source of information is in the student's hands, then the teacher can concentrate on her job and it becomes a very pleasant job. So you can say that without materials the plan has great weaknesses, but we believe that programed materials and others we have in mind can make it a very effective plan. Of course, the teacher must be extremely competent in evaluating and holding discussions with students and the students in turn must have mastered the study skills and be ready to accept responsibility for their own progress."

To summarize, let us review the guidelines that seem to emerge from my interviews:

1) It is necessary to develop a need for programed materials before introducing them into the classroom.
2) Programed materials should be used to supplement rather than supplant present teaching methods and materials.
3) Programed materials will work only as well as the total education context will permit.
4) Widely varying uses should be expected of programed materials, depending upon student aptitude, teacher attitude, grade level, and other factors.
5) A fully developed curriculum scope and sequence is required before programed materials can be adequately selected or developed.
6) Additional teacher time is required to teach with programed materials. Teachers can be assisted in this problem by assigning clerical duties to clerical personnel.
7) Teachers will need additional opportunities to become increasingly expert in diagnosis and evaluation of programed learning.
8) Children require time and assistance in adapting to the conditions of programed instruction.
9) A wide range of programed materials are required to accommodate the widely varying abilities of learners.
10) Effective learning from programed materials cannot be expected from all students, even if they have requisite ability, because of the difference in motivational factors, study skills, or work habits.
11) Teachers will need more academic competency to meet the demands of increasingly better informed and more sophisticated students who have had the benefit of quality programed instruction.
12) Parents must be given an opportunity to learn their role in helping children use programed instruction to best advantage.

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**Appendix:**

# Programed Instruction Today and Tomorrow (a reprint)

*The following is a reproduction of part of Mr. Schramm's earlier book,*

**Programed Instruction Today and Tomorrow**

*published by the Fund for the Advancement of Education in November 1962, and now out of print. It is reprinted here because of the continuing demand for it.*

The thesis of this report is that programed instruction is, in the best sense of the word, a truly revolutionary device but it is revolutionary not so much in itself, as in its ability to interact with certain other developments in education. This interaction has the potential of freeing schools and men from old bondage and outworn theories and practices. But the potential is, so far, largely unrealized.

I am going to try to make clear what I mean by talking about programed instruction as it is today, then about some of the currents in education which are boiling up around it, and finally about what it might be tomorrow, in connection with which I shall make some suggestions as to how a desirable rate and pattern of development might be encouraged.

But first let us be sure that there is no misunderstanding of what we mean when we speak of "programed instruction."

## What Is Programed Instruction?

By programed instruction I mean the kind of learning experience in which a "program" takes the place of a tutor for the student, and leads him through a set of specified behaviors designed and sequenced to make it more probable that he will behave in a given desired way in the future – in other words, that he will learn what the program is designed to teach him. Sometimes the program is housed in a "teaching machine" or in a "programed textbook." If so, the machine or the book is little more than a case to hold the program. The *program* is the important thing about programed instruction. It is usually a series of items, questions, or statements to each of which, in order, the student is asked to make a response. His response may be to fill in a word left blank, to answer a question, to select one of a series of multiple-choice answers, to indicate agreement or disagreement, or to solve a problem and record the answer. As soon as he has responded to the item, he is permitted to see the correct response so that he can tell immediately whether his response has been the right one. But the items are so skillfully written and the steps are so small between them that the student practices mostly correct responses, rather than errors, and the sequence of items is skillfully arranged to take the student from responses he already knows, through new responses he is able to make because of the other responses he knows, to the final responses, the new knowledge it is intended that he should command.

To sum up, then, these are essential elements of programed instruction: *a)* an ordered sequence of stimulus items, *b)* to each of which a student responds in some specified way, *c)* his responses being reinforced by immediate knowledge of results, *d)* so that he moves by small steps, *e)* therefore making few errors and practicing mostly correct responses, *f)* from what he knows, by a process of successively closer approximation, toward what he is supposed to learn from the program.[1]

However, there are two other characteristics of the making of programs which are very important in the total effect. Before a program can be designed, it is necessary to specify very clearly the desired end products – the responses the student is supposed to be able to make when he has completed the program, the skills and understandings to be learned. This requires a fresh look and often some hard thinking about the necessary content of teaching, an experience which is highly salutary and frequently results in long-overdue revision of courses and requirements. Secondly, when a program is being made it is necessary to test it. This is ordinarily done by trying it on one student, revising it to take care of the difficulties encountered in his learning experience, trying it on another student, revising it again, and so on until it has been tested on eight or ten individual students, at which time it is usually tested on large groups. Experienced programers feel that by the time eight or ten individual tests and revisions have been completed, the program is capable of teaching 98 per cent of all the students who approximate the school and ability level of the students so far tested. This process is a very important one because *a)* it focuses attention on the individual learning process in a way that group teaching seldom does, and *b)* it virtually guarantees that a program so made will "work." About a program so made, one feels a confidence that few textbooks can command.

It is obvious that what happens in programed instruction might well happen at a skillfully planned and organized tutorial session, in which the tutor leads the student along, question by question, toward given learning goals. A teacher is an ideal "teaching machine"; and excellent teaching, if it requires active responses by the student, employs strategy and tactics which we should

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1. We have described a Skinnerian type of program. About 19 out of 20 programs being made today are Skinnerian programs. There are other types, however. One of them is the Crowder type, represented in the Tutortexts which are in the form of scrambled books. Crowder's programs use the response as a test of whether the student has grasped an essential point of a passage of text, and provide for frequent errors by explaining why an erroneous response is wrong. There are also some training devices which are essentially programs, but not precisely of a Skinnerian type. Pressey's punchboards, employed usually as review tests, are also a type of program. All these devices, like Skinnerian programs, depend for their effect on some type of psychological conditioning, although whether it is Skinner's operant conditioning, Pavlovian or classical conditioning, or Guthrie's contiguity learning, or some combination, depends on the program and is to some extent a matter of disputed interpretation.

call a "program." In a sense, teacher training and preparation for classroom teaching is "programing" the teacher, although much teaching – for example, lecture teaching which minimizes active response from the student – does not make use of the methods of programed instruction. But no one contends that a very skillful teacher could not do whatever a program can do, at least as well as the program can do it – except in one respect: the teacher can tutor only one student at a time.[2]

## Programed Instruction Today

It is now ten years since a short paper by Professor B. F. Skinner, read to a conference of psychologists, printed in two journals and later several times reprinted, first called the attention of large numbers in the academic community to the possibilities inherent in programed instruction. During the last five years the method has gradually been coming to public notice, moving into the discussions of professional educators and school boards, into the plans of educational publishers and film makers, and into the stage of cautious trial and limited use in the schools.

### RATE OF DEVELOPMENT

Seven years ago, the skill of making programs was limited to a mere handful of persons, and the first purchasable programs had not yet come on the market. Now, hundreds of people have tried their hands at programing and have produced a very large number of programs and partial programs, of which several hundred, on every level from preschool to professional school, are presently available to schools who wish to buy them. Hundreds of schools and upwards of a million students have used these programs in instruction, and these numbers are due to be increased considerably.

On the whole, then, the rate of development in number and extent has been all that one could expect. There has been no corresponding rate of development in quality of programs, and yet the reports from the schools are generally good. The students learn from the programs, and enthusiastic comments far overbalance the complaints about "inefficiency" of materials, or "mechanizing" of teaching. There were at least two cases where indignant individuals in school systems demanded legislation barring programed instruction from schools. Whether this was due to poor programs, poor use of programs, or teachers who felt threatened, is not now known; and the storms seem to have blown over. Aside from a few reactions such as these, the chief negative comment from schools is that many students find the programs dull, and the second most common is that because of different rates of progress among students the programs are sometimes difficult for the teacher to administer. And these, as we have indicated, are overbalanced by reports that students like the programs, and that teachers find them helpful.

### ACTIVITY IN SCHOOLS AND TEACHERS COLLEGES

As yet, there has been no widespread movement of school systems to train their teachers in the expert use of programs, nor any general movement of teachers colleges to make use of programed instruction. This is somewhat surprising, inasmuch as programed instruction offers new opportunities to make improvements in what happens within the classroom, and also presents the teacher with a new series of problems. On the whole, schools have tended to absorb programs into familiar schedules and procedures, and have apparently not felt the need to conduct much in-service training. Relatively few summer workshops have been available to teachers who would like to learn more about how to make and use programs. Perhaps as a consequence, there has been little indication as yet of new and imaginative uses of programs in the classroom. For example, programs seem seldom to have been used as a member of the team in team teaching, or in any very exciting way to achieve the old goal of individual rates of progress, or combined in a new package with other kinds of teaching so as to make one unified and uniquely powerful learning experience. There may have been such, but they have not yet become widely known. As will be suggested later in this paper, such uses should be sought out and encouraged. It is not wholly surprising that in these first years, with both the programers and the users inexperienced, and therefore doubly anxious not to review or repeat too little, the programs should sometimes be dull and the uses sometimes unimaginative. But it is nevertheless a matter for regret.

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[2] The argument that programed instruction will replace the teacher is a kind of sensational and uninformed journalism which is unworthy of attention. Along with textbooks, teaching films and slides, instructional television, workbooks, chalkboards, and many other things, programed instruction is one of an arsenal of teaching devices at the command of the teacher to help him do his job better.

The teachers colleges might be expected to take more leadership than they have taken in this respect, both in training present and future teachers in the art, and in experimenting with classroom uses and with new types of programs. Programed instruction would seem to be a particularly powerful tool in teacher training because it focuses attention on the processes by which children learn, rather than on the way a teacher administers a classroom. The scarcity of activity of this nature has been rather disappointing.

### HARDENING OF PROGRAM STYLES

Another disappointing development is that programing seems to have somewhat hardened, rather than loosened and mellowed with a little age. Nineteen out of 20 programs being made today are Skinnerian programs, as we have said, and Crowder's own Tutortexts represent the only substantial production of Crowder-type programs. Even within the Skinner-type of program, there have been signs of hardening into a fixed and mechanical technology, based on the first programs and the first writing about programs. Many of the basic devices of programing have become requirements, and are being taken for granted on largely theoretical grounds, with little or nothing in experiment or use to justify them. One of the early advocates of programed instruction says that "if things continue the way they are now going, programing is going to become more and more of a 'word game,' a kind of didactic anagram or 'find the cue' affair. New programers must be shown the inadequacy of present techniques in getting the necessary mediating behavior out of the student. [Otherwise] programing will, I fear, 'freeze' right where it is for a long time to come."

### COMMERCIAL ACTIVITY

Part of this hardening is doubtless due to the fact that many relatively inexperienced programers are trying their hands at the art; part of it to the great commercial pressure to produce programs. In a new field of publishing, the race is to the quick. Traditional programs can be made more quickly, and sold more readily, than experimental ones. Furthermore, scholars are bribable. The lures of fat advances and substantial author's fees have diverted many talented scholars and teachers, who otherwise might have worked on the (non-lucrative but) growing edge of programing, into the making of orthodox and unimaginative (but lucrative) programs for commercial publication.

Once the potency of the new tools was appreciated, strenuous commercial activity began. At first this activity was largely in the making and peddling of machines. For a while there were many more machines than programs. Even the publishers were deluded. One respected firm sank $50,000 in an abortive attempt to create a machine. This went on for several years, during which the firm neither published nor commissioned a program. Finally, in 1959, it gave up on the machine, and turned its attention to the production of programed books.

Programs, chiefly in the form of programed books, have been the center of commercial activity for the last three or four years. Entrepreneurs have dashed around, signing up programers. Claims have been made in advertising that should not have been made. Stocks of companies which were announced as being in the process of producing programs shot up far beyond the levels their dividends would have predicted. Harcourt, Brace and World's *English 2600* has sold over 150,000 copies in the schools. Grolier is reported to have sold several hundred thousand TMI programs through its door-to-door encyclopedia salesmen, the Field Company to have sold a very large number of its Cyclo-Teachers by direct mail. Therefore, there has been good reason for commercial excitement. And although the publishers are now groaning over the cost of making programs and trying them out, the difficulties of handling programers and working with an unfamiliar kind of material, still there seems little doubt that programing will make considerable money for someone.

Regretfully, in a private enterprise country, one must admit that commercial activity in this field, so far, has been largely counterproductive to better programs and more imaginative uses. The publishers and film makers began to exploit programed learning before it was really quite ready. Faced with the need to risk large financial stakes in an unfamiliar situation, they made little attempt to find new kinds of programs or new uses of programs – rather they sought the more conservative types of programs and the more familiar uses. Faced with field reports on their programs, they tried to avoid expensive revisions. The incarnation of programs in programed books tended to harden the form at the moment when it should have been most flexible and most responsive to test findings and new technical developments. And it must also be recorded that the commercial agencies have supported almost no research on programing. Such research as has been done has come mostly from the universities, and been financed largely by the foundations and the National Defense Education Act.

## RESEARCH

There has been a considerable amount of research on programed instruction.[3] Indeed, no teaching medium has ever come into use in such an atmosphere of research – born, as it was, in a learning laboratory, nurtured on theory, and for some years knowing no friends except scholars.

This research leaves us in no doubt that programs do teach. A great deal of learning seems to take place, regardless of the kind of program or the kind of students. Even a bad program is a pretty good teacher. Programs have been used successfully at all levels of the educational system, at all levels of ability from slow learners to the very best students, and to teach a great variety of academic subject matter and verbal and manual skills.

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[3] Nearly 200 experiments had been reported by the beginning of 1963. These are abstracted in a volume about to be published by the U. S. Office of Education. For more information see the reading list at the end of the Appendix.

We can accept confidently, therefore, the conclusion that programs do teach. But how they teach, and what combinations of characteristics make them teach better, is still much in doubt. Some of the research results are puzzling and, to a good Skinnerian, sometimes astounding. There is very little evidence to prove that the constructed response, which is an important part of Skinner's theory, is in most cases any better than a selected response, or a subvocal response, or no measurable response at all. Several experiments have accomplished as much learning by filling in the blanks and letting students read the items like a textbook, and others by leaving the blanks but omitting the confirmation, as by the usual process of stimulus, response, and confirmation. "Maybe we ought to be publishing textbooks," said the head of one programing organization when he saw the results of such an experiment on one of his programs. It has been shown in a series of experiments that, for paired-associate learning, the system of prompting (showing the student the stimulus and response terms together) usually makes for just as much learning as, and takes less time than, the Skinnerian process of confirmation. A few experiments have even tried scrambling the order of a short program, and the most common result is no significant difference between the learning from the scrambled and the ordered programs.

Some of these results may be due to the way the research was done. Many of the experiments, for example, used very short programs and very small samples, and it is hard to generalize from these to real-life classroom conditions. It is unfortunate that not many of the most distinguished researchers have been attracted into doing experiments on programed instruction, and that most of the research so far financed has been of a short-term nature. But there are too many results at variance with the results predictable from theory to justify us in brushing them aside. I have just finished reading the report of six experiments at a West Coast university. The professors are plainly puzzled by their results. In the early experiments, they got so many results contrary to theory that they doubted their own measurements and worked hard to perfect their tests. Having done so, they still got much the same kind of result. They concluded that they had no evidence to believe that the standard Skinnerian program, used throughout their experiments, produced significantly better learning than any of several other forms, and that "the necessity of providing practice and reinforcement at each step of the program must be seriously questioned." It is clear, then, that programers are taking for granted a number of devices and rules of programing which are far from being adequately understood or confirmed by the evidence.

Although these uncertainties in research findings are disturbing, in another sense they are encouraging. There is every reason to hope that the use and study of programs, and the resultant focusing of attention on the processes of human learning, may feed back into the laboratory sufficient new information to make possible a major advance in learning theory. As Ernest Hilgard has said, the typical theory of learning may have little relation to what goes on in a human being when he learns. The need to study programed instruction should help to bring theory and actuality closer together. And if research on programs can illuminate learning theory, then we can be confident that improved theory will illuminate and improve programing.

In another way, also, the research is encouraging. It gives us every reason to believe that programs in the future *can* be vastly different and more effective. The experiments tell us, not only that we have much to learn about how to use and combine programing techniques, but also that programs will do some jobs we had not previously been sure they could handle. For example, Gagné and Brown demonstrated that programs could teach by "discovery," as well as by the usual kind of conditioning. There has been some evidence that programs can help to teach things like critical and sensitive reading of literature. Experimenters have shown that branching can be built efficiently into a Skinnerian program, so that remedial loops can be furnished for those who need them, and students who do not need additional practice or shorter steps can hurry along with giant steps. Experiments show, also, that programing can be adapted to a great variety of needs and audiences. Omar Moore uses a program to teach two- and three-year-olds to read and type. Certain programs taught a group of slow learners (mean IQ, 77) more than they had learned in any previous year of class teaching. Some remarkable things have been accomplished by using programs to telescope learning time. For example, a class of Naval reservists, needing a cram course in Russian, used a program for the purpose, and as each one finished the program he studied part of a grammar text and listened to tapes of a foreign language speaker. They studied for ten days, seven hours a day. Their instructor estimated that in the ten days they learned about as much as from a semester and one-half of a beginning college course in Russian.

It is obvious that the growing edge of programing is available if we can persuade some talented programers and scholars to work on it.

## OVERVIEW

Looking back over the first public years of programed instruction, then, we can record a swift growth rate in production and use, some encouraging evidence that programs teach, some research results puzzling as to *how* programs teach but encouraging as to how they may be made to teach *better*, and a premature hardening in program form and use.

Ironically, it might have been better for programed instruction if, at times during the beginning years, it could have been delivered from its friends. Its friends were sometimes too friendly, too full of enthusiasm to be critical, too absorbed in their own work to take a broad look at what was happening to programs, too close to developments to be good guides either for educators or for the public. There is a maxim of flying that a pilot needs altitude in order to make a good landing. In the first years of a dynamic new development it is hard to gain altitude over it.

If we must assess credit, it is the friends, rather than the enemies (if any) of programed instruction who must be credited with an emphasis on teaching machines rather than teaching programs, with extravagant claims of accomplishment and potential, with contributing their own rigidities to the somewhat rigid trends in the development, and with an emphasis on newness without defining the revolutionary quality of the newness.

The emphasis on machines derived from preoccupation with a machine that provided for review of missed items, and also from the experience of the military establishment with mechanical and electronic "trainers." It fed on the eagerness of industry to produce machines for the lucrative school market. The fact that to make programs was much more difficult than to make machines, and that most of these programs, once made, could be studied at least as effectively without machines, took several years to soak in. By that time, most of the lay public and many school boards and school administrators had filed programed instruction with water-coolers and air-conditioning, rather than with curricula and teaching method. There is no doubt that in the future some types of programed instruction will be conducted with the aid of machines; programs for pre-literates and language programs requiring both sound and sight are obvious examples, and the very bulk of paper in printed programs may force publishers to put their programs on film for use in a projector-type machine. But the premature emphasis on the teaching *machine* has served to distract attention from the teaching *program*, and from the really crucial questions about how students learn and how the activities in a school are to be selected and arranged in sequence and combined.

The extravagant claims for the new method are understandable and forgivable. The truth is, it is a very effective device for learning. The behavioral scientist was understandably proud that his science could make a major contribution, the effectiveness of which could be seen almost as readily as the great contributions of natural science. The entrepreneurs were understandably excited, and the highly competitive textbook industry was moved both to produce better products and to be first in a profitable field. It was not surprising that a group of advocates should develop. These advocates did both good and harm. They made the method known, but tended to hurry the rate of introduction beyond the rate of capability. Programs were introduced that were inadequately tested, and too hurriedly made. Teachers were made to feel threatened, rather than supported. Some schools were left feeling cheated because the programs were not miraculous. One wrote me, the other day, complaining that a certain program did "no better than a first-rate teacher." And in the research and teaching community, many able individuals who should have been studying how to make *better* programs than any now existing instead were tempted by "advances" to write programs by present-day standards – hurriedly, to meet a deadline.

Perhaps the less said about rigidities, the better. To some of the important figures in the early history of programed instruction there seemed to be one "right" way, and many "wrong" ways to program; one "right" theoretical position, and many "wrong" ones. This tended to close many doors to experimentation in programing, and led to many firm and authoritative statements about programed instruction, and inflexible policies in programing, at a time when the movement needed something else. We have no wish to point a finger at any individual, especially at any of those individuals who contributed greatly to the development of programed instruction. This is merely a note on another source of what we have called the premature hardening of the form and the use of programing.

The emphasis on "newness" is likewise easily understandable, and a good case may be made for it. But the very exaggeration of the language that has become common – for example, "the first prose ever constructed especially for the purposes of education," "the first really new tool of education since the printed book," and the like – has served again to distract attention from where it should be directed.

Students for thousands of years have followed instructional programs. Socrates had a program intended to teach his students right thinking and virtuous living. Music students have long worked toward professional competence by a program of finger exercises or vocal exercises. Most of us used a program of flash cards to learn multiplication tables or chemical formulas or foreign language vocabulary. In fact, most of us have learned to speak by means of a more or less formal program on the part of our parents, who prompted and reinforced certain desired responses. And for an impressively organized program of learning experiences, observe what a football coach does to a squad of awkward boys five afternoons a week!

The roots of programed instruction are deep both in the theory of education and psychological learning theory. Five hundred years ago, Comenius tried to specify a kind of education that would be active—that would cause a student to "learn more, and the teacher to teach less." Pavlov, Thorndike, Hull, Guthrie, and many others all demonstrated, before Skinner, how a laboratory animal or a human could be conditioned to make a given response to a given stimulus, and how a secondary reinforcer could be substituted for a primary one. The fact that Pavlovian or classical conditioning involves different manipulation from Skinner's operant conditioning, or that Guthrie's contiguity learning represents a somewhat different theory from Hull's drive-reduction or Thorndike's and Skinner's reinforcement theories, is a less important distinction than might be expected, in view of how "Skinnerian" programs are actually written, and what present-day research finds concerning the effectiveness of different forms of response and reinforcement in a verbal program.

Even Skinner's techniques of programed instruction were not wholly new. Pressey, in the 1920's, demonstrated by means of his punchboard the effectiveness of giving a student immediate knowledge of results. Several military training devices constructed in the 1940's and 1950's demonstrated the learning value of overt responses to a series of logically ordered stimuli, followed by knowledge of results. Student workbooks for years have been made on the assumption that constructed responses have a special value in learning. Skinner's contribution to this series of developments was to demonstrate a very simple, highly usable verbal learning device which is grounded in operant conditioning theory and has the ability to make maximum use of some very weak elementary reinforcers.

I am not trying to minimize Skinner's contribution. The trouble with the emphasis on "newness" was that it directed attention to the device rather than to the larger implications of the development. Skinner's teaching machine was obsolete before other users could get copies of it. The Skinner-Holland programs, even the best of present "Skinnerian" programs, are probably only weak foreshadowings of programs that can be made in the future. Research already raises certain doubts as to why people learn from Skinnerian programs. The device is clearly not the important thing. By concentrating on its newness, we distract attention from the truly new and important qualities of the development.

It is possible that, a decade from now, Skinner's contribution may be said to be that he built a bridge from the heartland of modern behavioral science (the growing knowledge of how human behavior is controlled and shaped) to the heartland of education (the growing technology for stimulating human learning). This bridge makes it easier for educators and behavioral scientists to go back and forth between their respective kingdoms, and the results of this are potentially much greater and more beneficial than anything which has yet come out of programed instruction. Just as the classical concepts of absolute time and space in Newtonian physics hindered for a long time the development of relativity theory, so did the classical concepts of absolute thresholds, absolute ability and intelligence, absolute readiness, and so forth, for a long time hinder the development of a true science of behavior, and in particular the application of such a science to education. It is therefore of the greatest importance that just at this moment when the elements of a behavioral science are on hand, the bridge should be open between the laboratory of the scientist and the laboratory of the school. Both the scientist and the educator stand to learn something of importance, and both theory and practice stand to gain.

It is of more than coincidental interest that the door of the schools should open for the behavioral scientist just at the time when the natural scientist and the mathematician have found the way back to the schoolhouse. For as we have tried to say, the development of programed instruction is of special importance in relation to the currents in education surrounding it, some of the most vigorous of which are set up by the renewed and active interest of physicists, chemists, biologists, and mathematicians in what happens in the schools. We must now be more specific about these currents, and how programed instruction relates to them.

## The Stage Setting for Programed Instruction

### THE CHALLENGE OF CURRICULUM

Wherever one looks in education today, he sees long-held and well-established belief and practice being challenged. Perhaps the most striking of these challenges is to curriculum. And amidst all the demands for change — demands that "life adjustment" or "progressive education" be abandoned, that the schools revise their offerings to support the national goals, that they return to something like the three R's, or phonics, or even the McGuffey readers and so forth — amidst all these, one of the most cogent and certainly the best implemented of the challenges comes from the scientists, who ask nothing less than that education change its basic purpose.

The return of the scientists, after a long period of disinterest, to an active concern with public school curricula, is itself a dramatic event. It is even more significant because these scholars are not content merely to criticize; they have insisted on dipping into school curricula, and preparing new materials. It is not surprising, these days, to find a distinguished professor of mathematics, ordinarily seen in university graduate classes, teaching a primary grade class because he wants to prove that set theory or geometric proofs can be taught at that level. The mathematicians and physicists got there first, but the chemists and biologists are not far behind. New mathematics materials have been prepared for most of the grades, a new physics course is available for high schools, and other materials are rapidly becoming available — made, for the most part, and often demonstrated, by university scholars who are motivated by a deep sense that science has been inadequately taught in the schools, and must be taught better.

Even a casual look at the new materials reveals how different these scientists feel science teaching should be. Gone is all the emphasis on the application of science and mathematics. Scientists are no longer much interested in having students taught how an electric power station works, or how to figure compound interest on a loan or to balance a budget. "Practical" science and "social" arithmetic are very far from the thinking of these scientists-turned-curriculum-makers. They care very little about how "useful" in everyday life a course is, and they really don't want a student to master the *content* of a subject. Any content he learns today, they say, will be obsolete tomorrow. Science regenerates itself every decade. The only kind of science that will be useful tomorrow is scientific *thinking*.

Therefore, what the scientists want to do with public school students is to teach them the thought patterns of mathematicians and scientists. They are not to be taught laws and theorems and relationships; they are to be taught how to *generate* and *discover* laws, theorems, and meaningful relationships. There is a neat distinction, in the vocabulary of these scientists, between what is *meaningful* and what is *useful*. Specific laws or formulas are useful in a transient way; but the ability to think in a highly generalized way, to perceive the interconnectedness of ideas, to be able to generate new laws and relate new observations to each other, is *meaningful*. In other words, what is important in science teaching is not the products of the science, but rather its *tools*.

So, in science classes, students are to be given practice in thinking like scientists. Even in their unpracticed ways, working with simple materials, they are to be encouraged to discover relationships and patterns, to develop theorems which Euclid may or may not have discovered before them, to discover over again the laws of probability and the principles of reflection and refraction. The key word is *discovery*. Students are not to be *taught* these laws and relationships; they are to be allowed to *discover* them. And by this method the scientists hope to substitute some of the joy of discovery for the deadliness of didactic teaching and memorizing. So taught, some of the best of the students will enter college better prepared to become scientists, and most of the students will be able, not only to understand some of the science around them, but also look at their own problems in a more nearly scientific way.

This is an exciting, a challenging approach to curriculum. And if we ask what is the place of programed instruction in this new kind of curriculum, then we must ask first what are the limits of teaching by discovery? How many skills, what store of knowledge, must still be taught by practice and memorizing? The scientists tend to be rather vague about this, but clearly there are many basic tools, such as reading, spelling, grammar, multiplication tables, to which discovery can make only a limited contribution. And how gifted must a teacher be if he is to teach effectively by discovery? Can anyone do it? Can it be done with a large group? A reasonable supposition is that not everyone can do it, and it does not lend itself to large-group teaching.

The basic ideas behind Skinnerian programing are quite different from discovery teaching. Like Thorndike, Skinner seems to be skeptical of transfer, and thinks of knowledge as consisting mostly of specifiable correct responses to specifiable stimuli. But is this the limit of programing? One of the most interesting articles in the research literature on programed instruction is the one by Gagné and Brown which demonstrates that a program can be constructed to teach by discovery. This is a finding of very great importance, for it points to the possibility of multiplying the efforts of the gifted teachers, and extending their influence beyond their physical presence and their available hours. It also points to a way of guiding discovery, to eliminate the wasteful randomness of much of it. However, it must also be pointed out that programs are not typically being made to teach by discovery, and if this is to become a major programing task then there must be an effort to develop this method of programing.

Even without discovery-programing, however, it seems likely that programs that teach by conditioning will still have plenty to do. In fact, the only way that teaching by discovery may be made practicable may be by turning the skills teaching, the routine work, the memorizing, over to programs, thus freeing the teacher for the demanding work of guiding the process of discovery. Thus, it is not at all unlikely that instructional programs and the new science curricula may prove to be able to do what neither could do alone, and together accomplish the revolutionary task of freeing students from outworn patterns of learning about science.

### THE CHALLENGE TO CONCEPTS OF APTITUDE AND READINESS

Educational psychologists and teacher trainers have been pretty stuffy about aptitudes and readiness. They have pointed out that at some point the child is ready to learn to read, at some other point to learn long division, at still some other point to begin geometry or Latin. They have even been willing to specify the age at which the average (or normal, or typical) child is ready for these experiences, and in general our curriculum has mirrored these "rules."

Furthermore, there has been a deadly inflexibility about student ability. Grade average was predicted in terms of IQ; if the student did worse than that, he was said to be working below his ability; if he did better than predicted, he was said to be an "achiever." So long as all students were taught exactly the same way, the IQs and aptitude tests stood up pretty well.

But suppose that readiness depends upon teaching method as well as upon subject matter? Suppose, for example, that a student is ready for the usual way of teaching geometry only in the tenth grade, but is ready for another way of teaching it as early as the second grade? Suppose that, as in the Soviet Union, intelligence tests were to be minimized; and when a child could not understand an explanation or a concept, the blame were to be laid not on the child's supposed lack of intelligence, but at least partly on the way the material is being taught? Suppose that test-makers were, as Cronbach and Glaser suggested they should, to think of their assignment not as selecting the fit from the unfit, but rather as selecting the kind of instructional methods which will fit different kinds of individuals?

This is the kind of revolutionary talk that has been heard in education for the last half dozen years, and has shaken the structure of aptitude and readiness beliefs from top to bottom. Most embarrassing of all, some of the teachers who have little respect for the readiness beliefs have gotten into the classroom, and have demonstrated pretty effectively that many of these beliefs are myth and folklore. Suppes and Page, for example, have been able to teach highly sophisticated mathematical notions in the first few grades, and Keislar has been able in the same grades to explain the phenomenon of dew in terms of molecular attraction. The students both enjoy and profit from this kind of teaching. Taking note of the fact that some children learn to read before they come to school, materials have been prepared to systematize and extend this early learning experience, and they are now being widely tested. The general conclusion, after this activity, is one that would have been laughed aside little more than a decade ago. Bruner stated it when he wrote, "any subject can be taught effectively in some intellectually honest form to any child at any stage of development."

Programed instruction becomes important in this little revolution because of its ability to fit its pace to the pace of a student, and because a program is necessarily made in such a way as to insure that it will teach a child of a given level. Using programed methods, Moore was able to accomplish his remarkable success in teaching two- and three-year-olds to read and type. Using programed methods, Stolurow was able to get truly surprising performance out of very slow learners. Using programed methods, bright high-school students in a number of places were able to study advanced mathematics, Russian language, and other subjects ordinarily studied in college – on their own, and outside class.

Thus programed instruction is a tool which should make it easier to break out of the traditional pattern of subject by age. As instructional television made it possible to teach foreign language in the elementary school although few elementary teachers were equipped to teach it, so programed instruction will increase the number of classrooms where subjects can be taught at an earlier age than they were formerly taught. Because the student is at the throttle, we shall find many more slow students learning a subject, and fewer bright students bored, than we found when the whole class moved at the same pace. Most important: the approach to program making is exactly the approach that is necessary in order to fit sophisticated subjects to young students. When you make a program, you work with a given set of required outcomes and a given group of children. You can't ordinarily blame a failure on the student's lack of ability or readiness; you can only blame it on a failure of the program – and you set about finding a form of program that will teach.

We don't know how far programed instruction can go in stretching limits within which a given subject is teachable, or speeding up the learning process beyond what has usually been taken as "average" progress. This will be a very exciting thing to work on in the next ten years. To give an example, suppose programed methods were now combined with other suitable tools in an all-out effort to speed the rate and increase the efficiency of learning to read. How much could the process be improved? The Russians claim that their students are farther ahead in reading at the end of their first year of school than our students are at the end of *two* years. If this is true, even allowing for the phonetic quality of their language, still there must be a difference in the efficiency of the teaching processes. If we could hurry up our teaching of reading one year or even half a year, in the first four years, if we could increase the efficiency of our teaching of reading only 25 per cent, scores of other educational problems would solve themselves. Given better readers, we should have better students in every academic subject, and incidentally, better students of programed instruction.

## THE CHALLENGE TO THE TRADITIONAL STRUCTURE OF EDUCATION

For many decades the self-contained and self-sufficient classroom was almost a tenet of faith for American education. The personal and unbroken relationship of a teacher to 30 to 35 students was considered necessary both for their sense of security and their efficient academic progress. Gradually a few inroads were made on that citadel. It was found that, if the teacher in charge were not herself musically trained or gifted, a visiting music teacher could enter the fortress without doing special harm. Physical education classes, if schools had them, tended to be moved outside the classroom and taught by a special teacher. Then, in the 1950s, the roof began to fall in on the self-contained classroom. Partly it was because special demands were made on teachers – for example, to teach foreign language or unfamiliar kinds of mathematics. Partly it was because teaching by television was tried and found to work, so that the best teachers could be shared more widely. Partly it was because the idea of team teaching began to make sense to educational administrators. Team teaching challenged the idea that 30 to 35 children was necessarily the right size for a class; some classes could be taught well with 100 students in the classroom, and others could not be taught well to more than five or six. It challenged also the idea that one teacher per year per class was necessarily the best use of teaching resources. The advocates of team teaching said that some teachers were more effective at one kind of teaching, some at other kinds; furthermore, some of the chores of a classroom teacher could be handled by clerks or graders, and the teacher freed to do what she was supposedly uniquely trained to do – teach.

While the roof was falling on the self-contained classroom, the foundation was crumbling beneath the related belief in a regular measured annual progress through the school grades. For a long time, schoolmen had been uneasy with this arrangement. They were aware of individual differences in ability and motivation, and tried various ways of making allowance for these differences. The idea of substituting unit texts and individual assignments for inclusive textbooks and common assignments was tried and worked well in some places, although it was always hard in a class of 30 to 35 to administer individual activities and rates of study. The multiple-track idea in which classes were segregated by level of ability, the most able classes getting an "enriched" course, and the least able ones a reduced or remedial course, proved easier to administer. In the 1950's, however, more radical solutions have been tried. One of these is the ungraded school. Another is the dual progress plan, proposed by scholars at N.Y. U. and tried in some nearby high schools. In this plan, the home room teacher takes the class for half a day, concentrating on tool subjects – e.g., grammar – and maintaining a fairly regular rate of progress per grade. During the other half of the day, under another teacher or teachers, the students are free to go at their own pace and follow out their interests and discoveries in subjects which lend themselves especially well to that kind of study – e.g., science. Thus a student might conceivably be studying Boolean algebra or the structure of the atomic nucleus, at the same time as he was studying sentence structure at the third-grade level. He might have some of his work with fifth, and some with eighth graders. As a matter of fact, he might be the only student in the school studying Boolean algebra. This is how far the growing edge of experiment in education has moved from the self-contained classroom.

It is easy to see how programed instruction fits into this development. Either the ungraded school or the dual progress plan presents a perfectly horrendous problem in scheduling and taking care of all the individual needs and assignments. *Any* structure that provides for individual assignments and individual rates of progress does present a severe administrative problem. The only ideal way to solve it is to have one teacher per subject per level. And the nearest approximation we can make to that ideal arrangement is to let programed instruction, where possible and appropriate, sit in for some of the teachers we don't have.

We probably have no teacher we can turn loose for ten hours of tutorial work to guide that bright third grader through the Boolean algebra which has excited and challenged him. But a program can do it. When a student gets to a point in his individual progress where he needs to know how to extract square root, and hasn't been taught it, are we going to ask a teacher to tutor him – or let him work through a self-instructional program on square root? I am not suggesting that students working at their own rates will do all their work in programed instruction. Far from it. They ought to read voraciously, and write, and explore, and discuss, and experiment. But they will find many topics where they need more help than a book will give them. They will find many areas in which they need to be guided toward discovery, rather than moving randomly around looking for something new. In some of these situations a teacher can guide them. But in many others a teacher will not be available, and here a good program ought to be most welcome and effective.

In fact it may be only through the wise use of programed instruction that the administrative difficulties of the ungraded school and the dual progress plan can be overcome with sufficient ease as to make the plans widely feasible. It would seem that a selection of excellent programs would be equivalent to adding expert and specialist teachers to the team. In particular, schools which are not ready to go to one of these advanced patterns, can add excellent visiting teachers in the form of programed instruction, without any risk to the relationships in the one-teacher classroom.

In short, the advent of programed instruction, just at this time, may administer the *coup de grâce* to the old dragon of progress-by-yearly-lockstep in the closed classroom.

### THE CHALLENGE OF THE EDUCATIONAL EXPLOSION

In this country we have what we call an "education explosion," meaning a great increase in the number of school-age children. Our education explosion is a mere toy pistol compared to what is going on in Africa, Asia, the Arab states, and Latin America. Sixty states in those areas are grasping for nationhood, trying to accomplish in a hurry the social and economic growth which older nations took centuries to accomplish. We recognize the education problem as important; these new nations recognize it as crucial. Before they proceed far along the road of development, well over half a billion people must be taught to read and write, and introduced to the simple computational skills. Hundreds of millions of people must be taught new practices in agriculture, health, and home management. Almost as many must be upgraded in occupational and mechanical skills. New industries, new public works, new service occupations must be manned, and new machinery must be operated. This whole complex of needs calls for a literacy teaching program, an expansion of school systems and technical training, an increase of in-service training and community development instruction. The total need is so vast as to be almost beyond comprehension.

Could an intelligent use of programed instruction significantly reduce the time and money required for that task? Everyone who is familiar with programed instruction and has looked closely at the needs of the new states is most optimistic about what could be accomplished. These countries are desperately short of teachers; here is a device to multiply good teachers. These countries have unusual motivations to learn; here is a device to take advantage of these motivations and provide a tool for self-teaching. These countries have need for a considerable amount of expert and specialized teaching which is often not within the competence of many of their teachers. Countless one-room schools are in charge of teachers who themselves have only four to six years of education. How much the learning opportunity in those one-room schools could be increased by the addition of a small library of well-made programs! This is the kind of possibility that leads observers to say that the greatest contribution of programed instruction to education may well be made in the developing countries.

Yet the introduction of programed instruction to developing countries presents some delicate problems, and must be accomplished with caution and insight. The problem is one of sharing skills, findings, and materials in a sensitive and culturally bound area. The United States, where most of the work on programed instruction has been done, must be prepared to share with the new states, and certainly will do so. *How* it does so is of the greatest importance. The new states must be encouraged to resist fast-talking salesmen who try to sell them programs and machines made in and for the United States. At the very least, these programs must be translated culturally as well as linguistically, and purchase of the machines may well be an unnecessary expenditure. Furthermore, a nation's education is a precious national possession and responsibility. The way to introduce a revolutionary new method like programed instruction into a national system is not to introduce materials but to introduce the method – to build up competence in the new country so that *it* can decide what programs it wants made, what use it wants made of the tools, what it wants to buy, and what teachers it wants trained in the new techniques. We are not certain how many American programs would be usable in any of these new cultures; we are not even certain what changes would be required in the programing method itself. Therefore, any introduction of programed instruction into a developing culture should be done in the spirit of trial. Research should be combined with development, and the findings should be shared as widely as possible, not only within the country but among the developing countries. Up to this point, we should be concerned with sharing our knowledge with the new states. Only after we understand the requirements of programing for the given culture, and only after the country has built up competence to make its own decisions about programed instruction, should we think of what materials of programed instruction we can *sell* the country.

But if we can introduce the method in this enlightened way, then the potential of programed instruction in national development is a most exciting and promising one.

We have already suggested other challenges to programed instruction – the challenge to contribute to a more adequate theory of learning; the challenge to make more efficient use of the learning capabilities of all children; the challenge to make better use of the learning capabilities of children at far ends of the capability spectrum, both the slow and the very swift learners; and the challenge to extend education efficiently beyond the school to correspondence students, self-teaching students, and students who need home work and practice to go with television instruction.

These are the things that are in our minds when we speak of the truly revolutionary qualities of programed instruction. The method is not revolutionary per se; it challenges schools *to be* revolutionary. Potent in itself, it will be doubly potent if it can be applied to problems like those we have mentioned in this section. The true revolutionary quality of programed instruction lies in its potential for helping to free man from inadequate curricula, from inflexible concepts of "readiness" and abilities, from the poverty of the self-contained classroom and the lockstep of annual progress, from generations of ignorance in traditional societies, from inadequate theories of learning and inadequate use of capacities to learn.

## Summing Up:
## The State of Programed Instruction

Looking back over the last pages to the thesis with which this report began, it is difficult to conclude that more than a tiny fraction of the potential of programed instruction is being realized. I should sum up the present state of programed instruction in these three propositions:

1) Although the research gives us little reason to be satisfied with the theories and the standards of today's programing, and every reason to believe that it will be possible some day to make programs vastly more effective than today's programs, nevertheless programed instruction shows signs of hardening, partly under commercial pressure, into a fixed and mechanical technology, with theories and procedures taken for granted.

2) Although programed instruction has within it the potential to turn the attention of education and educational research more intensively and productively than ever before to the processes by which humans learn, there is very little sign that it is being used productively to test theories of human learning or theories of cognitive process, or to enlighten the teacher concerning the process by which she teaches.[4]

3) Although programed instruction is essentially a revolutionary device, in that it has the potential to help free man from some of his bondage – the waste of human resources where there are no teachers or where people cannot go to school; the waste of time and talent where all students are locked into the same pace, and all teachers into the same routine; the tyranny of tradition which permits the study of a certain topic to begin only at a certain age, and expects a student to accomplish only as much as a questionable test of his ability says he can do; and the inadequacy of outmoded and inadequate curricula – despite this, programed instruction is very slow to rise to such a revolutionary potential.

## Programed Instruction Tomorrow

If this summary of the present situation bears some relation to reality, then we are in a position to make some projections into the future and suggest lines of healthy development toward the "revolutionary potential" of the method. It is not necessary to describe these in great detail. Here we shall merely set forth, so to speak, the skeleton of a desirable development, on which the scholars and builders of this field will know how to place the necessary flesh and blood.

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[4] A volume that represents a considerable contribution to theory is *Student Response in Programmed Instruction*, a collection of papers on research, edited by Arthur A. Lumsdaine. The experiments it contains derive not from the influence of Skinner, but rather from the tradition of research on teaching films begun during World War II under Hovland, and since carried on under the general direction of scholars like Lumsdaine. Therefore, this volume represents the confluence of another current of research with the Skinner current, and both have come together on the same group of variables—cueing, fading, confirmation of results, size of step, overt vs. covert response. It is the most important book of research yet published on programed instruction, and fulfills some of the promises of contributing to a theory or science of instruction which, as indicated above, has been expected from experiments in programed instruction.

1) More of the effort at making programs must be placed on the growing edge of the art, rather than the safe and conservative commercial "center."

2) More research must be directed toward the larger implications and theoretical problems of programed instruction; in order to accomplish this, long-term commitment of top-level researchers will be required.

3) The schools must make more imaginative applications of programed instruction, accompanied by developmental research and testing.

4) Teachers must be trained to use programed methods expertly; and the possibilities of making and using programs should be explored as one introduction to the human learning process in teacher training.

5) Other channels of teaching – such as television, textbooks, films and other audio-visual means, workbooks, class teaching, and group study – must be examined to see where they can beneficially apply some of the principles of programed instruction.

6) The skills and understandings of programed instruction must be shared with the developing nations, and used where possible to speed economic and social development.

7) Adequate channels of information must be established among the many and diverse people interested in the development of programed instruction.

This represents a very large program, but the stakes, too, are very large, and the goals most attractive.

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# Suggestions for Further Reading

There are a great many books and articles on programed instruction, and we can only name a few of them here. However, among the most useful volumes are:

*Teaching Machines and Programmed Learning,* edited by Arthur A. Lumsdaine and Robert Glaser (Washington, D. C.: National Education Association, Division of Audio-Visual Instruction, 1960). This is a collection of papers, including the famous articles by Skinner of 1954 and 1958, and a generally good introduction to the state of the art at the end of the 1950's.

*The Learning Process and Programmed Instruction,* by Edward J. Green (New York: Holt, Rinehart, and Winston, 1962) is an easy-to-read introduction to the Skinnerian approach to programing.

*Applied Programed Instruction,* edited by Stuart Margulies and Lewis D. Eigen (New York: Wiley, 1962). This is a collection of papers.

*A Guide to Programmed Instruction,* by Jerome D. Lysaught and Clarence M. Williams (New York: Wiley, 1963). This is a general introduction.

*continued*

There are a number of programed introductions to programed instruction. Of the three mentioned below, the first two are in linear form, the third in intrinsic programing in the style of N. A. Crowder.

*A Programed Primer on Programing,* by Susan M. Markle, Lewis D. Eigen, and P. Kenneth Komoski (New York: The Center for Programed Instruction, Inc., 1961).

*Programed Instruction: A Manual of Programing Techniques,* by Dale M. Brethower (Chicago: Educational Methods, Inc., 1963).

*Explaining Teaching Machines and Programming,* by David Cram (San Francisco: Fearon, 1961).

A useful little book on analyzing the objectives of programed instruction–or of any other kind of teaching–is Robert F. Mager's little book *Preparing Objectives for Programmed Instruction* (San Francisco: Fearon, 1962).

The 1964 Yearbook of the National Society for the Study of Education is entitled *Individualized Instruction,* and is edited by Ernest R. Hilgard (Chicago: NSSE). A number of articles in this volume deal with programed learning.

*Programs '63,* edited for the U. S. Office of Education by the Center for Programed Instruction, Inc., (Washington, D. C.: U. S. Government Printing Office, 1963) contains brief descriptions and page-long samples of all programs known to have been available in the United States by September 1963.

Abstracts of all the research on programed instruction carried out and reported prior to Spring, 1963, are to be found in a small book, *The Research on Programed Instruction,* prepared by Wilbur Schramm and published by the U. S. Office of Education (Washington, D. C.: U. S. Government Printing Office, 1964).

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